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LABYRINTHINE SYMPTOMS SUBSEQUENT TO FENESTRATION OF THE LABYRINTH

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THE NUMEROUS papers about the fenestration operation deal usually either with the technic or with the practical hearing results obtained. This paper serves another purpose. We have studied the spontaneous labyrinthine symptoms which are noticed immediately subsequent to the fenestration, also the fistula test. Since fenestration creates a fistula in the bony walls of the labyrinth, the operation offers a chance to study labyrinthine symptoms in man under circumstances which in the past could be produced only by experiments on animals.

The paper has two parts: one dealing with the immediate symptoms subsequent to the operation and the other dealing with the fistula test.

IMMEDIATE SYMPTOMS

The reports concerning fenestration of the labyrinth emphasize the symptoms occurring subsequent to the operation, such as dizziness and spontaneous nystagmus, but apparently no effort is made to offer a more exact description of these symptoms. It is for this reason that we have studied the symptoms in 12 cases of fenestration.

In the first twenty-four hours an exact observation is for obvious reasons not possible. Nevertheless, we have seen horizontal and rotatory nystagmus of the third degree directed toward the opposite or "unoperated" side. After twenty-four hours the patient remarks about a swimming or swaying sensation of the body and of objects as well. A definite whirling sensation is not frequent. There is horizontal and rotatory nystagmus of the third degree to the side of the fenestration. The nystagmus is manifest when the patient looks to the right or to the left. When the patient looks straight ahead the nystagmus likewise can be noticed, but frequently we found slow oscillatory movements of the eyes instead of the jerky movements of genuine nystagmus. The oscillatory movements of the eyes are synchronous with the pulse and are occasionally associated with nystagmus of the head. Pressure on the

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carotid artery of the ipsilateral side may accentuate the "pulsatile" movements of the eyes.

In the following days the subjective symptoms gradually decrease, but there still might be a slow swaying of the eyes or of the objects when the patient is reading. One week after the operation the patient no longer complains of dizziness, unless it is when he rapidly turns to one side, particularly to the side of the operation, when he looks upward, when he walks with closed eyes, when he bends forward or when he walks up or down stairs. These symptoms likewise gradually disappear; the length of their duration depends entirely on the patient's psychologic control.

The spontaneous nystagmus usually disappears in three to four days, although for a period of several days slight nystagmus might be observed when the patient looks extremely to the side operated on. The vascular symptoms persist with gradual subsidence to a slight degree six days after the operation, to become very faint by the end of twelve days. However, during this time physical exertion or movements, e. g., stooping, will bring out these symptoms to a greater degree. By the fifteenth postoperative day all traces of the symptoms have disappeared.

It is instructive to compare the labyrinthine findings subsequent to fenestration operations with the labyrinthine findings subsequent to surgical injuries of the semicircular canals. These findings were described by Jansen [1] in 1898 and were later confirmed by all otologists who had a chance to observe cases of this type. Jansen reported 13 cases, in 1 of which the superior semicircular canal, in 3 the posterior semicircular canal, and in 9 the horizontal semicircular canal, was injured. Nevertheless, the symptoms were essentially alike in all of these instances, although the intensity and the duration of the labyrinthine symptoms varied from case to case. Dizziness was disturbing immediately after the operation and was definitely diminished on the eighth day after the injury. However, slight dizziness could be elicited by rapid movements of the head even a few months after the injury. This finding is in agreement with the finding after fenestration. Perhaps after this operation the dizziness is not as marked as that subsequent to surgical injury of the horizontal semicircular canal. Vomiting is active after surgical injuries and ceases in from four to five days. In contradistinction, vomiting is not an outstanding symptom after fenestration, and under no circumstances does it continue for four to five days, unless there is secondary infection of the fenestra. Of great importance is the spontaneous nystagmus, which after surgical injuries is horizontal and rotatory, runs invariably toward the opposite (viz., not injured) side and disappears in from two to four weeks. As mentioned, subsequent to fenestration the nystagmus is likewise hori-

1. Jansen, A.: Ueber eine haeufige Art der Beteiligung des Labyrinthes bei den Mittelohreiterungen, Arch. f. Ohrenh. **45**:193, 1898.

zontal and rotatory, but twenty-four hours after the operation it runs invariably to the side of the fenestration and disappears in a few days. In other words, the nystagmus after surgical injuries of the horizontal semicircular canal, on one hand, and the nystagmus after fenestration of the horizontal semicircular canal, on the other, differ markedly in direction as well as in duration. Since under both circumstances there is the same lesion of the horizontal semicircular canal the difference concerning the nystagmus must be caused by the infection which is always associated with the surgical injury, while it is usually absent in fenestration. For the same reason, the hearing usually becomes moderately or even markedly impaired after surgical injuries, while after fenestrations it is frequently improved or does not change. These facts make it clear that the spontaneous nystagmus following fenestration deserves more attention than usually will be attributed to it. If the nystagmus is directed toward the side of the fenestration and decreases in a period of a few days, it is simply caused by the opening of the perilymphatic space. If, however, the nystagmus is directed toward the other side or if it continues for more than one week, it is probable that an infection of the fenestra has occurred and that, for this reason, the operation will not be successful as far as the hearing is concerned.

So far as the slow oscillatory movements of the eyes and the nystagmus of the head are concerned, these symptoms are not common in cases of surgical injury of the horizontal semicircular canal, but they do occur in cases of pathologic fistula of the horizontal semicircular canal, viz., fistula caused by an infection of the tympanic cavity or by syphilitic infection of the internal ear. At present the following hypothesis is supposed to explain the mechanism of the oscillatory movements of the eyes. Within the fistula there is hyperemic granulation tissue which contains pulsating blood vessels. Owing to the pulsation the endolymph is continually pushed to and from the ampulla, causing slow rhythmic movements of the eyes to the right and to the left. Granted that this hypothesis is correct, one must assume that the vascular symptoms subsequent to fenestration are caused by the hyperemia within the perilymphatic space which, in turn, is caused by the operation. For this reason the vascular symptoms disappear in seven to twelve days after the operation. It is evident that the vascular symptoms do not indicate an infection of the fenestra.

THE FISTULA TESTS

The fistula test is of great importance in cases of fenestration since it offers information concerning the patency of the fistula. It is surprising that in the papers dealing with fenestration the reports concerning the fistula test are usually incomplete. As a rule, the fistula test is performed with a cotton applicator, which is pressed against the fistula, and all that is told about the result of the examination is that the fistula

is active or not active. Since this type of examination is not satisfactory, we have examined the fistula symptom in twenty-four cases in which the operation was performed five weeks to fourteen months before.

First we examined the fistula symptom in the usual manner, namely, by pressing a cotton applicator toward the fistula. With this technic the fistula symptom was produced in 20 cases (table). As mentioned, this type of examination is not sufficient because (1) it does not allow an examination with aspiration and (2) it does not allow conclusions as to whether air waves originating in the external auditory canal may reach the fistula. For this reason we examined the fistula symptom by compression and by aspiration of the air of the external canal. We put a rubber tube into the external auditory canal, connected it with a Politzer bag and exerted compression and aspiration. Furthermore, we examined the vascular fistula test of Mygind [2] by exerting pressure on the carotid artery. In none of our 24 cases did the vascular fistula test yield positive results. The results of the other test are presented in the accompanying table.

Results of Fistula Tests

Method	Total Number of Cases	Cases in Which Results Were Positive		
		Compression	Aspiration	Compression and Aspiration
Cotton applicator.....	24	20 (84%)		
Politzer bag.....	24	18 (75%)	18 (75%)	18 (75%)

The table proves that the examination with the cotton applicator yields positive results more frequently than does the examination with the Politzer bag. In our series there was no case in which sounding of the fistula gave a negative and compression with the Politzer bag a positive result, but there were 2 cases in which a positive result was recorded for sounding of the fistula and a negative result for air compression with the Politzer bag. There was one exception in a case in which the fistula did not respond to sounding but did respond to aspiration of air, although the nystagmus was atypical viz., to the side of fenestration. These findings prove that the technic of probing the fistula with a cotton applicator is inadequate and does not permit conclusions concerning the motility of the labyrinthine fluids and the status of the sensorial organs within the internal ear. In fact, experiments have proved that probing of a fenestra may elicit nystagmus even in instances in which the turning and the caloric tests no longer yield positive results (Uffenorde [3]). It is in agreement with this experience that in all

2. Mygind, S. H.: Ein neues Labyrinthfistelsymptom, Ztschr. f. Ohrenh. **77**: 70, 1919.

3. Uffenorde, W.: Experimentelle Prüfung der Erregungsvorgänge in Vestibularapparate bei den verschiedenen Reizarten am intakten und eröffneten Labyrinth ein Affen, Beitr. z. Anat., Physiol., Path. u. Therap. d. Ohres **5**:332, 1911-1912.

instances in which the fenestra responds to probing but not to air compression the results as far as the hearing is concerned are poor. For this reason, after fenestration the fistula test should be performed with the Politzer bag and not with a cotton applicator.

On examining the fistula symptom with the Politzer bag it was found that air compression produced the symptom in 18 cases, aspiration in 18 cases, and compression as well as aspiration in 18 cases. Compression yielded a typical fistula symptom in all instances, viz., nystagmus directed to the side of the compression. An inverted fistula symptom, namely, nystagmus directed to the opposite side, did not occur in our series. The "complete fistula symptom" of Zytowitsch, namely, prolonged compression, we did not apply. These findings are important because among the 18 cases there were 11 in which the fistula was at the ampullar end of the horizontal semicircular canal or in front of it, while in the other 7 the fenestra was at the convexity of the canal. According to the theory, air compression should cause opposite movements of the endolymph with these two localizations of the fenestra, and, for this reason, the directions of the nystagmus likewise should be opposite. Since, however, air compression caused in either case the same type of nystagmus, one must conclude that the point at which the fistula is placed within the area of the horizontal semicircular canal does not exert any influence on the results of the fistula test.

Air aspiration yielded in 14 cases a typical fistula symptom, viz., nystagmus directed to the opposite side, while in 4 cases the fistula symptom was atypical; i. e., the nystagmus was directed to the side of the aspiration. If in the latter cases the compression likewise caused nystagmus, air aspiration and air compression caused the same type of nystagmus, a finding which again is not in agreement with the present view concerning the function of the semicircular canals.

As it likewise occurs with pathologic fistulas, a positive result of a compression test does not necessarily indicate that the aspiration test also will produce the fistula symptom. In this series there were 3 cases in which compression produced this symptom while aspiration did not. In all of these cases probing of the fistula likewise produced the symptom. So far as the hearing was concerned there was impairment in 1 case, slight improvement in 1 case and a good result in 1 case. In 3 other cases the compression test gave a negative result while the aspiration test gave a positive result, yielding typical nystagmus (to the opposite side) in 1 case and atypical nystagmus (to the side of aspiration) in 2 cases. Sounding of the fistula gave a negative result in 1 case, a slightly positive result in 1 case and a questionable result in 1 case. So far as the hearing was concerned in these instances, there was slight improvement in 2 cases and no improvement in 1 case.

All of these findings may be obtained in the case of pathologic fistula as well as in the case of fenestration, but in neither case is there a

satisfactory explanation. Important, too, is the fact that these atypical findings of the fistula test are not necessarily caused by inflammatory changes within the perilymphatic space, since they may be obtained in cases of fenestration without additional infection. The question as to whether or not these atypical results of the fistula test indicate diminished function of the fenestra requires further study.

CONCLUSIONS

1. Twenty-four hours after fenestration of the labyrinth there is horizontal and rotatory nystagmus of the third degree to the side of the fenestration, which disappears in three to four days, while after surgical injury of the horizontal semicircular canal there is horizontal and rotatory nystagmus of the third degree to the other side, which persists for two to four weeks. This difference is caused by the infection which is always associated with surgical injuries, while it is usually absent in fenestrations.

2. Twenty-four hours after the operation there are frequently slow oscillatory movements of the eyes, synchronous with the pulse, when the patient looks straight ahead. There is occasionally nystagmus of the head.

3. If after fenestration of the labyrinth the nystagmus is directed toward the side of the fenestration and decreases in a period of a few days, it is simply caused by the opening of the perilymphatic space. If, however, the nystagmus is directed toward the other side, or if it continues for more than one week, an infection of the fenestra is likely to occur.

4. Slow oscillatory movements of the eyes and nystagmus of the head do not indicate an infection of the fenestra.

5. The examination of the fenestra with a cotton applicator yields positive results more frequently than does the examination with the Politzer bag.

6. There are cases in which sounding of the fistula produces the fistula symptom while air compression with the Politzer bag does not produce it.

7. After fenestration of the labyrinth the fistula test should be performed with the Politzer bag and not with the cotton applicator.

8. The point at which the fistula is located within the area of the horizontal semicircular canal does not exert any influence on the results of the fistula test.

9. Atypical findings with the fistula test do not necessarily depend on inflammatory changes in the perilymphatic space.

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HISTOGENESIS OF CORPORA AMYLACEA OF THE COCHLEAR AQUEDUCT, THE INTERNAL AUDITORY MEATUS AND THE ASSOCIATED CRANIAL NERVES

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LITTLE is known about the function of the cochlear aqueduct. Since a number of surgical procedures are concentrated on the perilymphatic spaces, it is felt that a thorough knowledge of the normal and the pathologic histology of this duct is indispensable. It is commonly assumed that the cochlear aqueduct is a communicating link between the perilymph and the spinal fluid. The present study was undertaken in order to clarify the histogenesis, the nature and the function of the so-called corpora amylacea of the cochlear aqueduct.

Habermann [1] described these round blue-staining bodies of the cochlear aqueduct as observed in 7 specimens and felt that they originated from the degenerated vessels which later on became encapsulated by connective tissue cells of the arachnoidea. Meurman [2] gave the same explanation for the formation of these bodies. He found corpora amylacea almost always present in persons over 12 years of age but never in those below the age of 7. Wittmaack suggested that corpora amylacea occasionally might obstruct the cochlear aqueduct and cause vertigo.

It was Boettcher [3] who first described corpora amylacea in periosteum of the internal auditory meatus as small calcium concretions. He found these to be present only in adults of the advanced age group. Alexander and Obersteiner [4] described corpora amylacea in the peripheral portion

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From the Department of Otolaryngology of Columbia University, the College of Physicians and Surgeons and the Presbyterian Hospital.

1. Habermann J.: Beiträge zur pathologischen Anatomie des Gehörorganes, Ztschr. f. Heilk. **8**:347, 1887; cited by Meurman.[2]

2. Meurman, Y.: Zur Anatomie des Aqueductus cochleae nebst einigen Bemerkungen über dessen Physiologie, Acta Soc. med. fenn. duodecim (ser. B, fasc. 1, no. 1) **13**:1-75, 1930.

3. Boettcher, H.: Ueber das Vorkommen von Kalkablagerungen in der Beinhaut des inneren Gehörorganes, Virchows Arch. f. path. Anat. **12**:104, 1857.

4. Alexander, G., and Obersteiner, H.: Das Verhalten des normalen Nervus cochlearis in Meatus auditorius internus, Ztschr. f. Ohrenh. **55**:78, 1908.

of the acoustic nerve itself. They claimed that these bodies occurred only in the transitional zone of the nerve, as a result of degeneration of glial cells. They found corpora amylacea in the cochlear nerves only of persons over the age of 26. After the fifth decade corpora were encountered more and more frequently by these authors. Nager [5] considered the corpora amylacea of the eighth nerve postmortem artefacts and called them psammoma bodies.

METHOD

The present investigation is based on the studies of 70 temporal bones in serial sections selected at random. The ages represented in this series ranged from 3 days to 86 years with equal representation throughout all age groups. In 19 instances both temporal bones were examined. In addition to hematoxylin-eosin stain, iodine stain was extensively used in order to demonstrate the inner structure of the corpora amylacea.

OBSERVATIONS

Size.—The average size amylaceous body measures 0.03 mm. in diameter, but quite frequently much smaller (0.01) or larger (0.05-0.1) ones are encountered.

Shape.—With very few exceptions, those in the internal auditory meatus and around the seventh and ninth cranial nerves are round, while those encountered in the cochlear aqueduct are more frequently elongated or elliptic (figs. 3 and 5). However, in some instances, when iodine stain was employed, it was possible to demonstrate that some of the bodies which appeared pencil-shaped or club-shaped with the old hematoxylin-eosin method consisted in reality of two or more adjoining round bodies.

Staining Properties.—With hematoxylin-eosin some of the corpora amylacea may appear as structureless bodies staining from light to deep blue. In others three to sixteen concentric rings are visible, alternating in color from light to deep blue (figs. 4 and 5). These rings are separated from each other by dark "cement lines." With iodine stain, all corpora amylacea take up a deep brown color and demonstrate the concentric layers whether located in the cochlear aqueduct or in the internal auditory meatus. Arachnoidal cluster cells (precursors of corpora amylacea) seem to have more affinity to iodine stain than the surrounding arachnoidal reticulum of the aqueduct. During the process of decalcification of the temporal bones the calcium salts of the corpora amylacea are likewise removed. What remains is probably starchy

5. Nager, F. R.: Ueber postmortale histologische Artefakte am Nervus acusticus und ihre Erklärung, ein Beitrag zur Lehre der Corpora amylacea, Ztschr. f. Ohrenh. **51**:250, 1906

in its chemical character, which led to the name of "corpora amylacea," although starch is not the only component of these round bodies.

Age Factor.—Corpora amylacea are found in greater or lesser number in the fundus of the internal auditory meatus in every specimen over 3 years of age (fig. 2). Over the age of 6 they are regularly

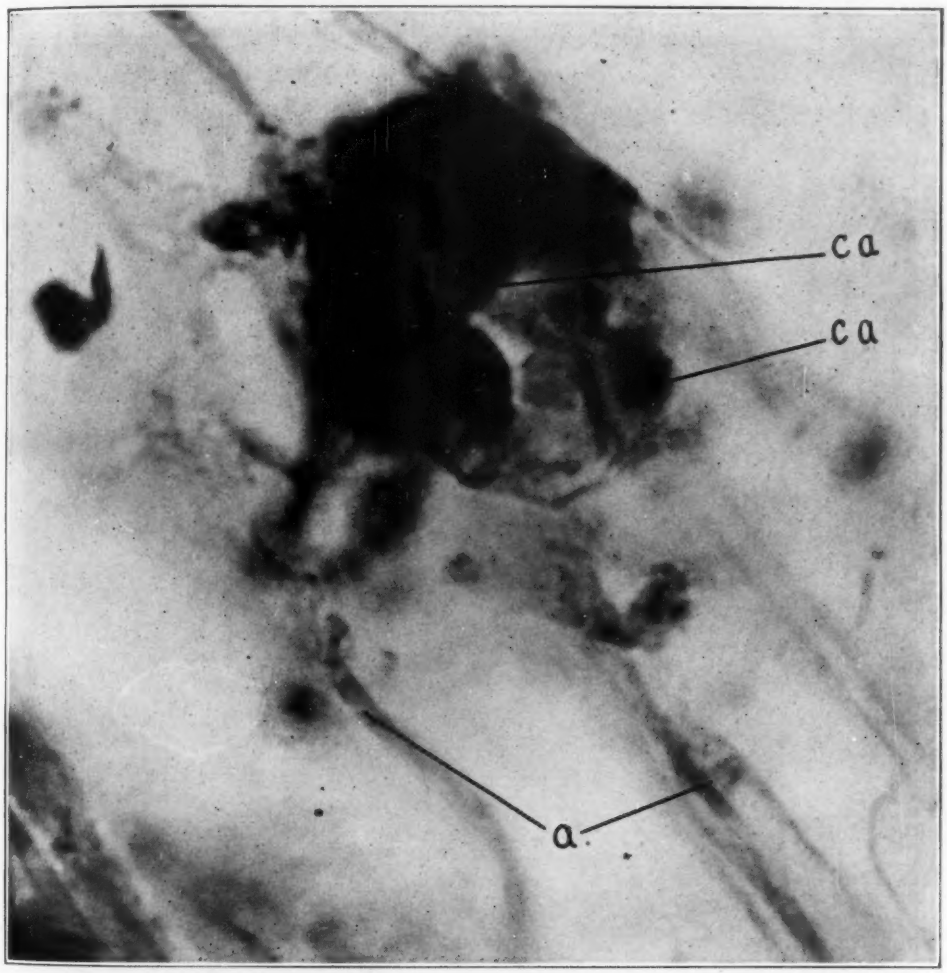

Fig. 1.—High power photomicrograph of a section of the cochlear aqueduct of an 11 month old infant. Note partially infiltrated arachnoidal cell cluster containing cells with indistinct outlines. Note the arachnoidal reticulum (*a*) and the partially developed corpus amylaceum (*c a*).

present in the cochlear aqueduct. An approximately equal occurrence of corpora amylacea is found to be present in both the cochlear aqueduct and the internal auditory meatus of the same person in a large number of specimens after the age of 6. No major difference in

the incidence of corpora amylacea is noted between the right and the left temporal bone. Corpora amylacea are easily visualized in the arachnoidea and the dura surrounding the glossopharyngeal nerve in all instances in which the sections contain the region of its ganglion at the inferior opening of the cochlear aqueduct. This was universally true in the age group above 6 years. Corpora amylacea are only

Fig. 2.—A corpus amylaceum (*c a*) in the dura of the acoustic nerve in the internal auditory meatus of a 3 year old child. Note the concentrically arranged arachnoidal ghost cells (*g c*) within this body. (*d p*) dura-periosteum.

occasionally found around the facial nerve, usually in the bony canal not far from the geniculate ganglion, while many times those same specimens contained a large number of these bodies around the acoustic nerve.

Although the temporal bones of older people usually contain more corpora amylacea than those in the younger age groups, there are numerous exceptions. The number rarely exceeds two or three in any individual section of the cochlear aqueduct in the young age groups, however one 9 year old specimen contained as many of these bodies as

Fig. 3.—The cochlear aqueduct 2.8 mm. from the scala tympani in a 9 year old child. The width of this duct is 0.13 mm. at this level. Note the great number of corpora amylacea (*c a*), which occupy most of the lumen. Note also the bony wall (*b*), the dura-periosteum (*d p*) and the petrous bone (*p b*).

any of the oldest ones in this series (fig. 3). On the other hand, several bones of the fourth and fifth decades contain few corpora both in the cochlear aqueduct and in the internal auditory meatus. Corpora were not found in any of the bones under the age of 3. The number

of these bodies is invariably small (one or two) in any individual section up to the age of 7. Transitional forms or half-developed corpora amylacea—e. g., cell clusters—are found with equal frequency in all age groups (fig. 1).

Corpora amylacea seem to be a normal histologic landmark in the cochlear aqueduct of specimens more than 6 years of age. Their

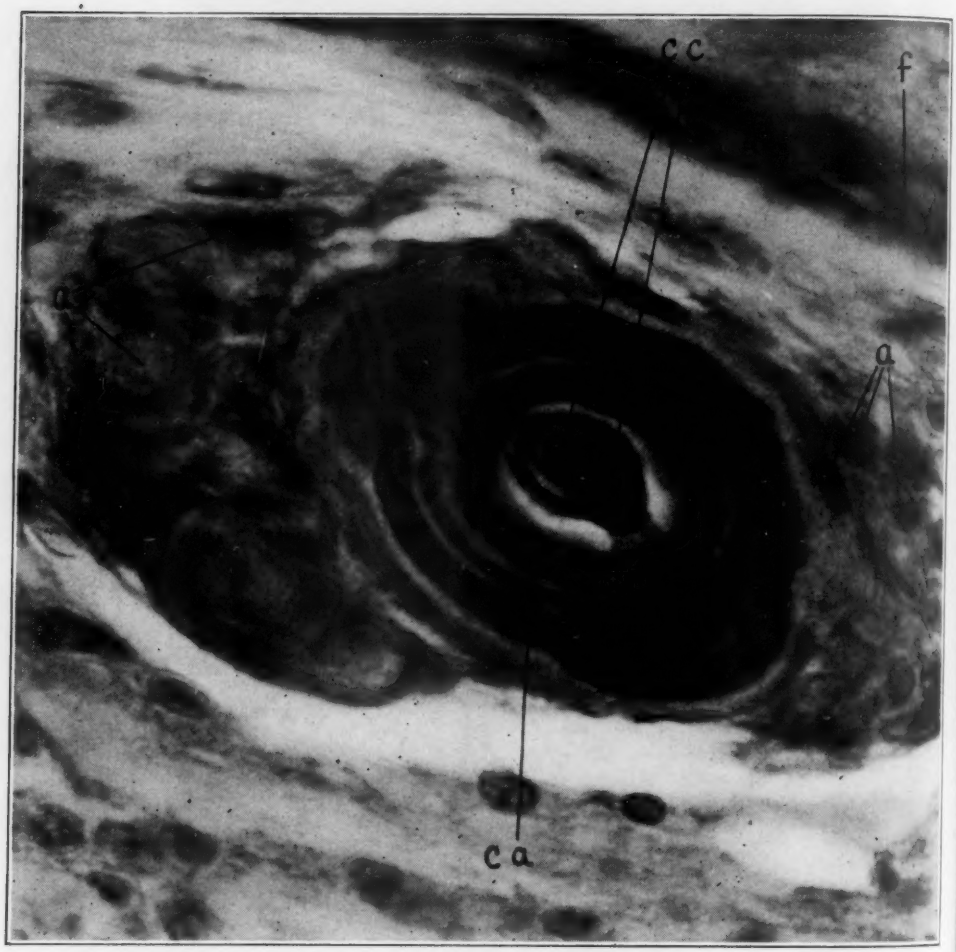

Fig. 4.—A corpus amylaceum (*c a*) under high power located in arachnoidea of the acoustic nerve of a 43 year old man. Note the concentric layers of this body, in the center of which the outlines of two cluster cells (*c c*) are visible. The corpus is surrounded by partially infiltrated arachnoidal cells (*a*). (*f*) Bony fundus of the internal auditory meatus.

absence is usually associated with the absence of the arachnoidal reticulum, which not infrequently is pulled out while the petrous bone is being removed from the skull or during preparation of the sections.

Corpora Amylacea in Relation to Disease.—Diseases do not seem to have any specific influence on the formation of the corpora amylacea —e. g., purulent infections of the leptomeninges and the inner ear (16 bones in this series), and generalized bone disease, such as Paget's disease (3 cases). However, the specimen which contained the greatest number of these bodies both around the eighth and around the ninth

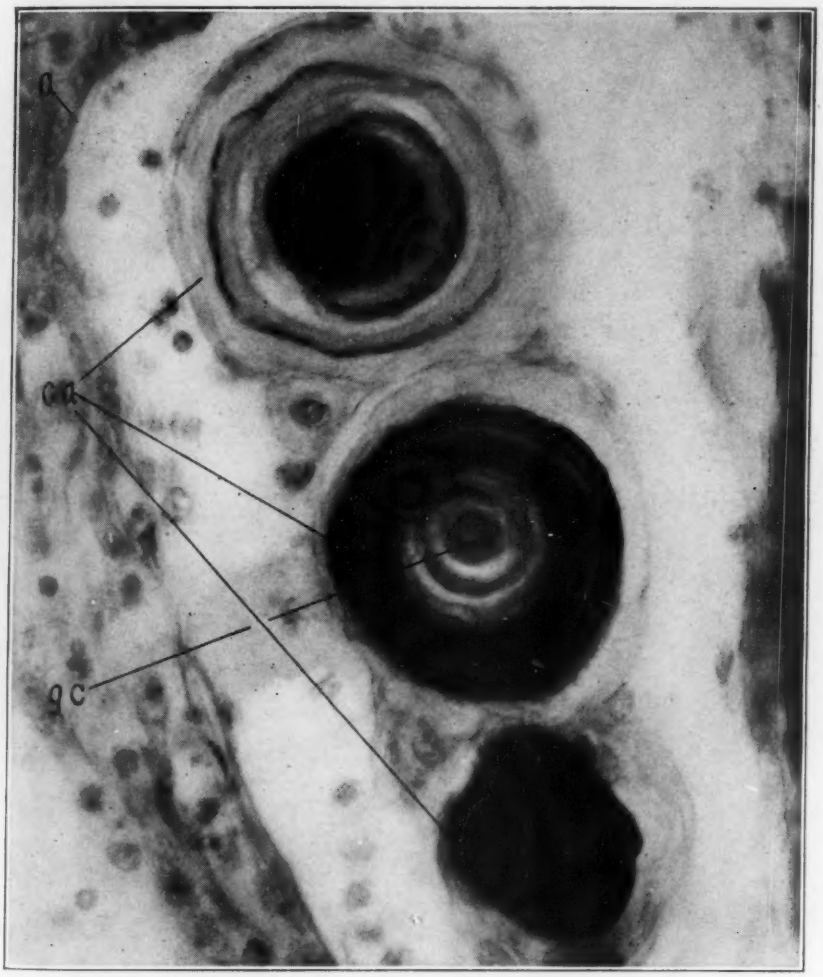

Fig. 5.—Three corpora amylacea located within the internal auditory meatus of a 52 year old man, demonstrating progressive stages of the development. Note the indentation of the arachnoidea (*a*) of the acoustic nerve by the growing corpora amylacea (*c a*). At the center of one corpus is a ghost cell (*g c*).

cranial nerve and in the cochlear aqueduct originated from a patient 65 years of age who died of Pneumococcus type 3 leptomeningitis.

Location.—Corpora amylacea are found along the entire course of the cochlear aqueduct, extending from the wide inferior opening at

the basis of the skull in the cerebellar fossa to its internal opening into the scala tympani near the round window membrane. Occasionally, typical round bodies are found within the scala tympani of the basal coil of the cochlea but always close to the opening of the aqueduct.

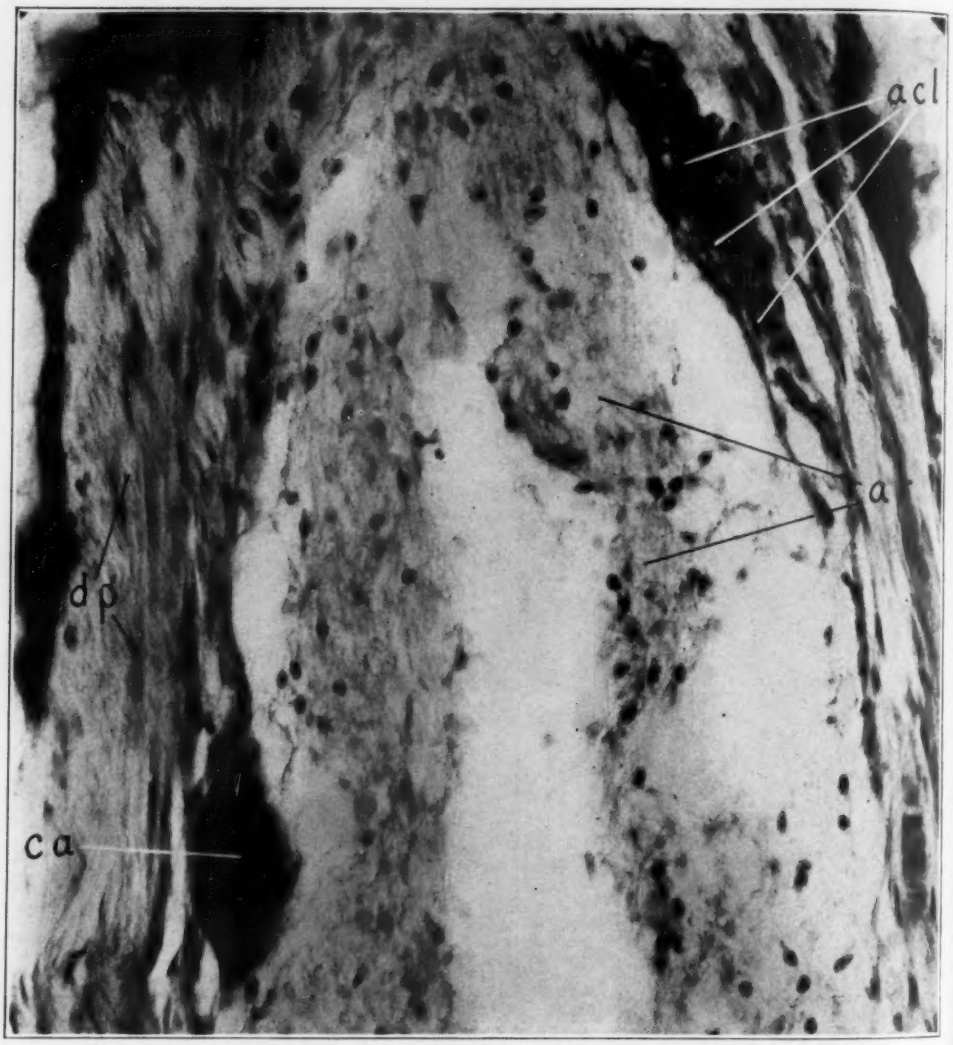

Fig. 6.—Section of the cochlear aqueduct of a 68 year old man located 4 mm. distally from the scala tympani. Note two stages in the development of the corpora amylacea: (1) typical arachnoidal clustered cells (*a c l*) with indistinct cell boundaries and (2) a corpus amylaceum (*c a*) containing ghost cells. (*d p*) Dura-periosteum. (*a r*) Arachnoidal reticulum.

Most of the corpora amylacea and the cell clusters of the internal auditory meatus are found in the fundus or not far from it. Occasion-

ally corpora amylacea are found in the meninges covering the branches of the vestibular nerve in the bony canals which lead to the vestibular end organs.

Relationship to the Meninges.—Cell clusters and corpora amylacea are most frequently found in the arachnoid reticulum of the cochlear aqueduct (figs. 3 and 6), in the arachnoidea of the eighth (figs. 4 and 7) and ninth cranial nerves, or in the subdural space. Somewhat less frequent is their occurrence within the dura of the same cranial nerves (fig. 2) and the periosteum of the cochlear aqueduct (fig. 8), which periosteum from the embryologic point of view is a dura-equivalent.[6]

Histogenesis.—One or more ghost cells of the arachnoidal type are visible in the center of many of the amylaceous bodies (figs. 2, 4 and 8). The nuclei and cell boundaries of these ghost cells are not

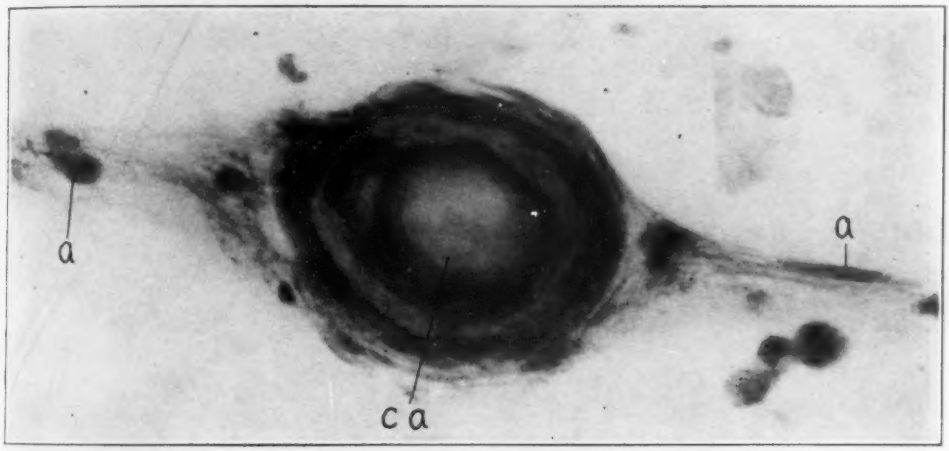

Fig. 7.—A fully developed corpus amylaceum (*c a*) in the internal auditory meatus of a 16 year old boy. It is intercalated within a single layer of arachnoidal cells (*a*), indicating its arachnoidal origin.

recognizable in most instances. Frequently whorls or clusters of arachnoidea-like cells are present side by side in the same section together with corpora amylacea (figs. 4, 6 and 8). The nuclei of the clustered cells are larger than those of the surrounding arachnoidal reticulum of the cochlear aqueduct and of the internal auditory meatus. The cluster cells are closely packed, round, with more or less recognizable cell outlines. Similar formations were described by Cushing and Weed,[7] particularly along the venous sinuses of the hemispheric

6. Waltner, J. G.: Development of the Cochlear Aqueduct and the Round Window Membrane in the Human Embryo, Arch. Otolaryng. **42**:239 (Oct.) 1945.

7. Cushing, H., and Weed, L. H.: Studies on the Cerebro-Spinal Fluid and Its Pathway: Calcareous and Osseous Deposits in the Arachnoidea, Bull. Johns Hopkins Hosp. **26**:367, 1915.

dura. In a large number of the temporal bones examined in this series all stages of transformation were found, varying from arachnoidal cell clusters to partially infiltrated forms of the same clusters to homogeneous amylaceous bodies containing ghost cells. The infiltration of the cell cluster starts in the center more frequently that on the periph-

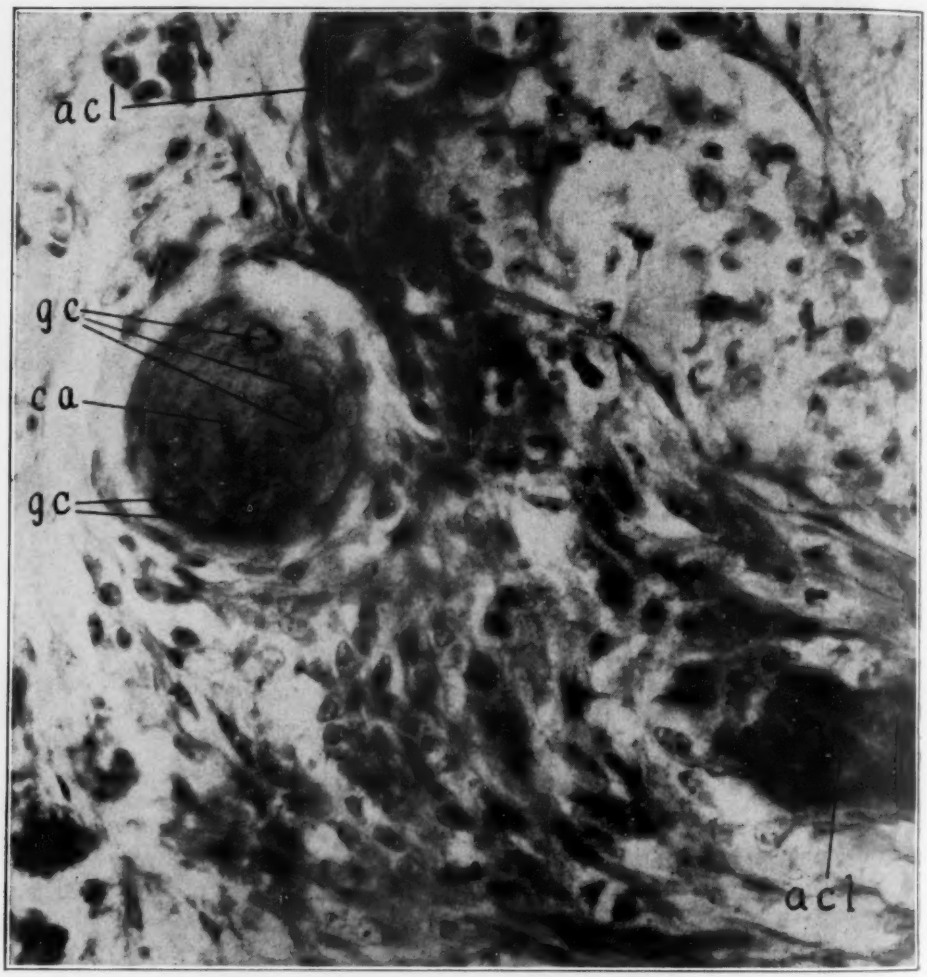

Fig. 8.—Arachnoidal cluster cells (*a c l*), with indistinct cell boundaries, and a corpus amylaceum (*c a*) containing several ghost cells (*g c*). These are located in the dura-periosteum of the cochlear aqueduct of a 43 year old man.

ery. The deep blue–staining center of the amylaceous body is frequently surrounded by a pink-staining ring which still contains faintly recognizable ghost cells, thus pointing to the chronology of the infiltration. Some of the circular bodies are surrounded by a crown of cluster cells which at a later stage of development, having undergone

infiltration, would add an additional homogeneous ring to the amylaceous body (fig. 4). The cluster cells bear close resemblance to similar cellular formations which one frequently finds in the arachnoidal reticulum of the cochlear aqueduct in older fetuses.[6]

COMMENT

There are several facts which speak against the theory that the corpora amylacea are artefacts. They were never found in fetuses or in bones up to the age of 3 years, although the same histologic preparation and staining technic was used with all specimens. In addition, the gradual increase of the number of corpora amylacea from the age of 3 to 8 years cannot be a mere coincidence. The frequent coexistence of (1) arachnoidal cell clusters, (2) partially infiltrated clusters containing ghost cells, and (3) fully developed corpora amylacea in the same section weighs most heavily in favor of the corpora being a standard histologic feature both in the cochlear aqueduct and in the meninges of the eighth and ninth cranial nerves.

The reticulum of the cochlear aqueduct can be regarded as an equivalent of the arachnoidea from a histogenic point of view.[6] It is not surprising, therefore, that corpora amylacea occur both in the aqueduct and in the meninges of the seventh, eighth and ninth cranial nerves. They show identical staining properties and are located in the same spatial relationship to the meninges; their number in the aqueduct and around the nerves in any individual section is approximately the same. The cell clusters show much the same affinity to iodine stain as do the corpora amylacea. This is additional proof in favor of their arachnoidal origin as it has been shown in a foregoing section that the cell clusters are derived directly from the arachnoidea.

In the internal auditory meatus corpora amylacea are found three years (3 year old specimen) prior to the occurrence of the same findings in the cochlear aqueduct (6 year old specimen). On the other hand, cell clusters which represent a stage leading to the formation of amylaceous bodies are not infrequent in as young a specimen as 11 months of age (fig. 1). By most workers (Essick[8] and others) aging seems to be the accepted explanation for the formation of corpora amylacea in the meninges. This finding was not substantiated, however, in this series, as fully developed corpora amylacea were first found at the age of 3. Three years represent such a short time in a man's life that age alone is not the only factor in the formation of these bodies, and they are certainly not signs of senility.

8. Essick, C. R.: Formation of Macrophages by the Cells Lining the Subarachnoid Cavity in Response to the Stimulus of Particulate Matter, Publication 42, Carnegie Institution of Washington, 1920, p. 379.

Whatever the cause of the formation of these bodies may be, it seems to be quite evident that the same circulating substance reaches the arachnoidal cells in quite distant parts of the skull and then takes part in the infiltrating process of the arachnoidal cell clusters. It still remains an open question why certain cell clusters which are already recognizable in older fetuses have more affinity to the infiltrating substance than other cell clusters. The perivascular reticulum around the cochlear vein develops with the reticulum of the cochlear aqueduct,[6] and thus is equally arachnoidal in origin. The fact that corpora amylacea were never found by me around the cochlear vein is suggestive that the substance which infiltrates the arachnoidal cell clusters to form corpora amylacea originates from the spinal fluid rather than from the blood.

The deep brown staining of corpora amylacea with iodine points to a starchy component. The typical blue reaction was not obtained in any of the specimens stained with iodine. When iodine stain is used, corpora amylacea, which stain a deep homogeneous blue with hematoxylin-eosin, frequently show concentric rings. This may be due to the action of the hydrochloric acid in the stain which may dissolve the calcium-containing substances and thus may reveal the underlying, slightly wavy, onion-like layers. Therefore polysaccharides may be the main but not the only constituents of the amylaceous bodies.

I have yet to come across a specimen in which the lumen of the cochlear aqueduct was completely obliterated by corpora amylacea. In the narrow portion of the aqueduct, 1 to 2 mm. from the cochlea, however, a large number of bodies are found, which are frequently responsible for a marked narrowing of the lumen. The intimate relationship of these bodies to the surrounding tissues makes it almost impossible for the corpora amylacea to get free into the spinal fluid or perilymph.

The cochlear aqueduct is never found as an open canal connecting the scala tympani to the subarachnoidal spaces. The marked narrowing of the bony aqueduct at a distance of 1 to 2.5 mm. from its opening into the scala tympani of the cochlea and the ever present reticulum in the lumen will always prevent a rapid flow of the spinal fluid. Many times the reticulum is so dense in the narrow portion of the aqueduct that an exchange of fluids through the duct seems to be impossible unless other factors like slow diffusion through the dense reticulum play an important role. The only physiologic role of the corpora amylacea could consist of further reducing the lumen of the aqueduct and further slowing down the flow of the spinal fluid. The maze of reticulum and whorls of spinal fluid caused by the irregularly scattered corpora amylacea should check an undue increase of pressure in the perilymphatic spaces of the labyrinth. Special experimental studies are being made to determine whether the subarachnoid space has any outlet to the perilymph.

Almost all of the corpora amylacea surrounding the acoustic nerve are found close to the fundus of the internal auditory meatus in the arachnoidal blind sac. This peculiar location of the corpora amylacea may have something to do with the slowing down of the current of the spinal fluid or may be the result of the stagnation of the spinal fluid in the arachnoidal blind sac. The latter consideration is likely to be another explanation for the presence of the corpora amylacea in the cochlear aqueduct.

In view of the foregoing observations it would not appear likely that one could consider corpora amylacea to be either pathologic entities or artefacts. Cell clusters are frequent in the reticulum of the cochlear aqueduct of older fetuses [6] and young infants and they are the precursors of the amylaceous bodies.

SUMMARY

Corpora amylacea are small round or elliptic bodies measuring 0.01 to 0.1 mm. in diameter. They frequently show a structure made of many concentric layers and stain deep blue with hematoxylin-eosin and dark brown with iodine.

From the age of 6 years corpora amylacea are standard anatomic features in every cochlear aqueduct, while from the age of 3 they occur regularly around the acoustic nerve. They are equally frequent in the meninges which envelop the ganglion of the glossopharyngeal nerve at the inferior opening of the cochlear aqueduct.

Corpora amylacea develop from the arachnoidal cell clusters, which are already recognizable in a fetus measuring 135 mm. from crown to rump. These cell clusters which develop from arachnoidal cells undergo progressive infiltration to become eventually mature corpora amylacea. Most of the cell clusters and corpora amylacea are found in the arachnoidea or in its equivalent, i. e., the reticulum of the aqueduct. Somewhat less frequent is their occurrence within the dura-periosteum of the aqueduct.

Sex and pathologic change do not have any influence on the number and the size of the corpora amylacea. Their number in the aqueduct shows a striking parallelism with that in the internal auditory meatus. In both locations they can be traced back to the same embryonic mother tissues.

Corpora amylacea are normal histologic features of the cochlear aqueduct, the physiologic role of which probably is the additional slowing down of the flow of the spinal fluid.

The presence of corpora amylacea both in the reticulum of the cochlear aqueduct and in the arachnoidea of the cranial nerves appears to give additional proof of the identical embryonic origin of these two structures.

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SEVERE PURULENT INFLAMMATION OF THE UPPER RESPIRATORY TRACT CAUSED BY NEISSERIA INTRACELLULARIS

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IT IS now universally accepted that in the body the primary site of multiplication of the meningococcus is the nasopharynx. From this site the organisms may or may not find their way into the blood stream and produce the symptoms of septicemia. When septicemia occurs, the likelihood that there will be a secondary localization in the meninges is great, though many cases of meningococcemia without meningitis have been reported. There may be localizations in many other tissues, such as the joints,[1] the structures of the eye,[2] the sex organs [3] or, more rarely, in the heart or the lungs,[4] sometimes without meningitis. All of these localizations are regarded as being secondary to the invasion of the blood stream.

Recently a number of cases of meningococcic conjunctivitis have been reported in which there was no preceding septicemia.[5] In these cases, therefore, the infection was either primary in the eye or secondary to a previous infection of the nasopharynx. This point has not been made clear. In some of the cases the conjunctivitis was followed by septicemia and meningitis, which suggests the possibility that infec-

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2. Duke-Elder, W. S.: Textbook of Ophthalmology, St. Louis, C. V. Mosby Company, 1938, vol. 2, p. 1547.

3. Latham, J. R.: Epididymitis as a Complication of Meningitis, Cerebrospinal: A Study of Twenty-Four Cases, J. A. M. A. **72**:175-177 (Jan. 18) 1919. Armytage, J.: Unusual Infections with the Neisseria, M. J. Australia **2**:360-361 (Sept. 30) 1944. Carpenter, C., and Charles, R.: Isolation of Meningococci from the Genitourinary Tract of Seven Patients, Am. J. Pub. Health **32**:640-643 (June) 1942.

4. Brinton, D.: Cerebrospinal Fever, Baltimore, Williams & Wilkins Company, 1941.

5. Theodore, F. H., and Kost, P. F.: Meningococcic Conjunctivitis, Arch. Ophth. **31**:245-247 (March) 1944. Hays, F. B., and Chamberlain, R. D.: Meningococcal Conjunctivitis: Report of Case, U. S. Nav. M. Bull. **46**:758-760 (May) 1946.

tion of the eye may be another mode of entry of the organism. However, in none of the cases of conjunctivitis that we have seen reported has the nasopharynx been excluded as the primary portal of entry.

In the majority of persons who became infected with meningococci the infection does not go beyond the nasopharyngeal stage. Such persons are called carriers, a name which implies that the organisms are merely growing on an otherwise normal membrane. However, agreement among observers on this point is by no means complete. Flexner [6] stated that carriers were practically all free from symptoms. Murray,[7] on the other hand, stated that swabs from the nasopharynx of the carrier were usually charged with a peculiarly tenacious mucopus, and he regarded the nasopharyngeal membrane as the principal barrier against invasion of the blood stream, phagocytosis and lysis being the mechanisms of destruction exerted. It has been the general observation that in a high percentage of the cases meningitis is preceded by symptoms of infection of the upper respiratory tract, though the nasopharyngeal stage has been bacteriologically studied only at autopsy in cases in which death occurred early in the course of meningitis. It appears to have been extremely rare that meningitis has been diagnosed in that stage, even in such circumscribed outbreaks as those that have occurred in army barracks. Henry and Kuhn [8] reported 3 cases of meningococcic coryza in which sulfanilamide was administered and neither meningococcemia nor meningitis developed.

The case which we shall report is considered worthy of report in that it shows the capacity of the meningococcus to produce an infection of the upper respiratory tract of moderate severity and suggests the possibility that the making of a diagnosis in that stage may have prevented the more serious complications of meningococcemia or meningitis.

REPORT OF A CASE

The patient was a woman member of the staff of the department of bacteriology of the University of Oregon. The account of the clinical course of the infection as given here is almost entirely her own story: An acute cold developed with the usual symptoms of sneezing and watery discharge of the nose, which continued for four days. These symptoms were almost completely alleviated on the fifth day, when suddenly a productive cough developed, which in a few hours became severe and was accompanied by increasingly painful sensations deep in the throat, apparently in the trachea. The patient was restless and unable to sleep. She had not taken her temperature, but until some hours after the cough and the tracheal sore-

6. Flexner, S.: Mode of Infection, Means of Prevention and Specific Treatment of Epidemic Meningitis, Monograph, Chicago, American Medical Association, 1917.

7. Murray, E. G. D.: The Meningococcus, Medical Research Council, Special Report Series, no. 124, London, His Majesty's Stationery Office, 1929.

8. Henry, L. D., and Kuhn, H. A.: Meningococcic Coryza, Arch. Otolaryng. **30**:991-992 (Dec.) 1939.

ness developed had not experienced any sensation of abnormal warmth. However, some eight to ten hours after the aforementioned symptoms appeared, she noticed a feeling of excessive warmth and found her temperature to be 100 F. The sputum now became more abundant and assumed a purulent character. As her temperature continued around 100 F., she remained in bed for the next two days. During this time the symptoms continued practically unchanged, except that the deep soreness in the throat was somewhat alleviated.

On the seventh day following the onset of the cold the patient came to the laboratory, where she examined a gram-stained specimen of her sputum, and was somewhat startled to find that the bacteria consisted almost entirely of large numbers of gram-negative diplococci having the morphologic characteristics typical of Neisseria. Pus cells were abundant, and many of them contained the gram-negative cocci in great numbers. There were large numbers of these organisms extracellularly as well. Steps were taken at once to isolate and identify this organism, and after a few days it was shown to be Neisseria intracellularis, group I.

Shortly after examining the direct smear the patient consulted Dr. Charles N. Holman at Multnomah Hospital, Portland, who reported as follows: There were mild inflammation of the trachea and bronchi, acute congestion of the nose and purulent inflammation of the nasopharynx. The lungs were not involved, and there was no swelling or tenderness of the regional lymph nodes and no tenderness over the paranasal sinuses. The picture was that of an ordinary acute infection of the upper respiratory tract.

Dr. Holman suggested that the patient remain in bed until her temperature became normal. He did not feel justified in starting specific sulfonamide therapy for meningococcic infection until the identity of the organism had been confirmed by culture.

With complete rest the patient's temperature subsided about 0.2 degree daily, but the postnasal discharge and the cough remained about the same, and the sputum became, if anything, more purulent and more copious. Marked tenderness of the cervical lymph nodes developed in the next three days. At the end of this period the leukocyte count was 9,700, 78 per cent of which were polymorphonuclear cells, and the erythrocyte sedimentation rate was 60 mm. in forty-five minutes by a method for which the normal upper limit is considered to be 15 mm. in forty-five minutes.

About a week after the onset of the cough and the purulent nasopharyngeal inflammation, the identity of the organism having been established, the patient was started on a course of sulfadiazine treatment consisting of 3 Gm. initially, followed by 1 Gm. every four hours. A sulfathiazole spray was used locally in the throat and the nose. Within twelve hours the cough declined markedly and the postnasal discharge lessened. Within twenty-four hours the cough had almost completely disappeared and the nasal passages were clear. The patient's temperature became normal, and she returned to the laboratory. The chemotherapy continued for three days, but a completely normal state of health returned within forty-eight hours.

Bacteriologic Data.—As has been stated, the first inkling that the symptoms were being caused by meningococci came from a gram-stained smear in which large numbers of intracellular and extracellular Neisseria-type organisms were present. Smears were stained repeatedly throughout the subsequent course of the infection, and they continued to show numerous intracellular and extracellular organisms and few or none of other types. When treatment was started, this picture changed rapidly. The meningococci could not be found after twenty-four hours, and the normal gram-positive flora reappeared.

The first cultures of the purulent postnasal discharge were made on chocolate Douglas agar plates, incubated in 10 per cent carbon dioxide, and on a plain blood agar plate, which was incubated in the open air of the incubator. The chocolate agar plates after twenty-four hours contained large numbers of colonies of typical Neisseria type, small and watery, and few other organisms. The blood agar plate, on the other hand, showed few colonies, none of them of the Neisseria type. In subsequent cultures the organisms continued to show this characteristic of abundant growth on chocolate agar in carbon dioxide and failure to grow at all on blood agar in air.

Just before chemotherapy was begun, streak plates of the exudate gave large numbers of colonies of the meningococcus, and a plate held a few inches in front of the mouth during a spell of coughing showed development of several hundred colonies, evenly distributed. On the latter plate no colonies other than those of the meningococcus appeared. Cultures made on the day following the beginning of treatment yielded only a moderate number of colonies of the meningococcus. On the second day, the sputum having become scanty, no Neisseria-type colonies appeared on the plates. Cultures were made a number of times during the next three weeks, both of material from the throat and of that from the nasopharynx. None of them yielded any colonies of the meningococcus, but they showed a gradually increasing abundance of colonies of staphylococci and alpha streptococci.

The organism in these various cultures was identified as Neisseria intracellularis on the basis of the following tests: It fermented glucose and maltose but not sucrose. It failed to grow on unenriched extract mediums or on chocolate agar at room temperature. It was agglutinated by a commercial group I antimeningococcus serum (Lederle) to a dilution of 1:160 but failed to agglutinate with group II and group IIa serum in a dilution of 1:20.

COMMENT

We justify the assumption that this case is one of meningococcic inflammation of the membranes of the nasopharynx, trachea and bronchi on the basis that the organism was found in the exudate in large numbers, extensively phagocytosed by the polymorphonuclear cells, and that other types of organisms were practically absent throughout the course of the infection. That the infection was primary in the nasopharynx is indicated by the absence of any symptoms of an invasion of the blood stream such as high fever, toxemia and the purpuric lesions of the skin so constantly reported in meningococcemia. Unfortunately, no blood cultures were made. No other local tissues, such as the conjunctivas, were involved. It seems not unlikely that meningococcemia would have developed, and possibly also meningitis, if specific treatment had not been carried out or had been much longer delayed. The fact that the patient's symptoms suddenly changed on the fifth day of her illness from those of an acute cold to those of a purulent inflammation suggests that either a meningococcus was implanted at this time on a membrane favorably conditioned for its growth or a meningococcus already present on the healthy membrane was stimulated into activity by the changes occurring during the cold. Once the meningococcic infection was established, it showed no tendency to yield ground until sulfonamide treatment was started.

The potential role of the patient as a source of infection of others is indicated by the profuse culture obtained on the cough plate and by the persistent and uncontrollable nature of the cough. The subjective symptoms were such as to require her to remain in her own home only a part of the time during which the organisms were probably being expelled. It seems probable that many of the reported cases of meningitis and meningococcemia with antecedent infections of the upper respiratory tract have been of the same type. And it is not improbable that some of the patients recover without these more serious complications. The lesson from this case is clearly that more attention should be given to determining the exact nature of the causative organisms in cases of inflammation of the upper respiratory tract, especially in those in which this is accompanied with purulent discharges and coughs.

EARLY TREATMENT OF MAXILLOFACIAL BATTLE CASUALTIES

A Résumé of Four Hundred and Twenty-One Cases

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THIS is a résumé of the cases seen by a plastic maxillofacial surgery team of an auxiliary surgical group attached to one of the United States armies. It covers the period including the Battle of Normandy, the Battle of France, the Battle of the Ardennes, the Battle of the Rhineland and the Battle of Central Germany. The work was done in evacuation hospitals.

It is not a detailed account of all the work done, nor is it a detailed description of individual cases. It is intended only to call attention to certain principles and to mention in summary fashion some of the more interesting and unusual aspects.

STATISTICAL STUDY

Total number of operative cases	421
Total deaths	3
Mortality rate	0.712%

(Note: Of the 3 patients who died, 2 had associated extensive cerebral damage and 1 had an associated penetrating wound of the large bowel.)

Breaking the collection of cases down into an anatomic and descriptive classification presented a problem; hence it was decided to employ as nearly as possible a grouping related to the operative treatment, as follows:

1 Wounds of soft tissues	233
(*a*) Requiring split skin grafting	11
(*b*) Requiring flap closure or some type of plastic procedure other than débridement and suturing	100
(*c*) Requiring only débridement and suturing	122

Mr. Herbert C. Hunter and Mr. Peyton Atterbury prepared the drawings from sketches done in the operating room.

The skill and assistance of Medfred S. Riley, D.D.S., Wichita Falls, Texas, and of Bertram H. Downs, D.D.S., Colorado Springs, Colo., materially enhanced the quality of the work reported.

The principles herein set down were first discussed in a meeting held for the plastic and oral surgeons of one of the United States armies at the Hôpital Villemin, Nancy, France, on Nov. 7, 1944. The meeting was arranged by Russell L. Malcolm, M.D., Richmond, Ind., and supervised by Charles B. Odom, M.D., New Orleans, La.

2. Fractures of the facial bones 189
   (*a*) Mandible 69
   (*b*) Maxilla 52
   (*c*) Malar bone 28
   (*d*) Nasal bone 23
   (*e*) Frontal bone 17
3. Wounds involving the accessory nasal sinuses 56
   (*a*) Maxillary sinus 42
   (*b*) Frontal sinus 10
   (*c*) Ethmoid sinus 4
   (*d*) Sphenoid sinus 0
4. Penetrating wounds with high explosive fragments which required operative approaches for their removal 43
   (*a*) Deep structures of the face 22
   (*b*) Deep structures of the neck 21
5. Wounds of the neck involving the larynx, trachea or pharynx and requiring tracheotomy 9
6. Wounds involving the orbital structures 22
7. Injuries involving the great vessels of the neck requiring ligation 1
8. Penetrating wounds of the neck with relatively large hematomas, small wounds of entrance and small high explosive fragments 4
9. Multiple penetrating wounds of the face with numerous small lacerations from primary or secondary high explosive fragments, and blast injuries of the face with myriads of small fragments which were superficial 42
10. Facial wounds with peripheral facial paralysis 11
11. Facial wounds involving the parotid gland or duct 20
12. Burns of the face and neck 10
13. Abscesses and infections of the face and neck requiring incision and drainage 6
14. Wounds involving the floor of the mouth, the tongue and pharyngeal structures 38
15. Wounds of the soft and the hard palate 18

As would be expected, the number of wounds classified exceeds the total number of operative cases, since often 1 patient had wounds falling in more than one category.

A listing of the operative procedures will further clarify the type of work and will be found to fit in with the classification of the wounds:

1. Split skin grafting 11
2. Closure of skin and subcutaneous tissues requiring some type of plastic procedure 100
   (*a*) Sliding flaps and mucous membrane–bearing flaps for reconstruction of the lip 70
   (*b*) Repair of auricular defects 5
   (*c*) Z plastics 2
   (*d*) Closure of wounds by extensive undermining without the use of additional incisions 6

(*e*) Repair of the lip undermining and advancing mucous membrane and V sections..... 17

3. Primary suture of wounds whose size and shape required only moderate undermining and direct approximation..... 122
4. Caldwell-Luc approach to the maxillary sinus..... 22
5. Intranasal antrotomy..... 14
6. Frontal sinusotomy, external route..... 8
7. External exenteration of the ethmoid cells..... 4
8. Fixation of the mandible by various wiring methods..... 69
9. Fixation of the maxilla by various wiring methods..... 32
10. Fixation and/or elevation of the zygoma..... 28
11. Elevation of depressed fractures of the frontal bone..... 4
12. Tracheotomy 9
13. Exposure of deep cervical structures for removal of high explosive fragments 11
14. Procedures for fractured nasal bones..... 23
15. Unusual approaches for inaccessible high explosive fragments in deep facial structures..... 10
16. Excision of old cicatrices with primary closure..... 4
17. Removal of thyroglossal duct cyst..... 1
18. Biopsy of suspicious lesions of the lips..... 3
19. Incision and drainage of abscesses..... 6

(This gives a total of 472 operative procedures on 421 patients.)

It is well at this point to make a few general comments. No distinction was made between face wounds that were superficial and those that were deep so far as the decision to close them was concerned, provided certain conditions were met. These were drainage when indicated, absence of gross infection and adequate toilet of the wound. These will be further elaborated in the development of the paper.

The entire aim in this work has been to accomplish as much as possible at the first operation, using reconstructive procedures when this was practicable but always being cognizant of the important principle of not doing any operation which if unsuccessful would preclude the final successful outcome of plastic surgical procedures to be done in the zone of the interior. We used temporary reconstructive measures and were aware of their shortcomings at the time. (See section on split skin grafting of wounds.)

In a word, it is felt that any one stage flap operation that is completed in that stage is capable of being accomplished in the first treatment of maxillofacial battle injuries. No stage of a plastic procedure involving another operative site should be started at this period in the treatment.

The proved and accepted principles of early care of subjects of maxillofacial surgery should be adhered to, but in our opinion more

can be done with a greater margin of safety than is generally realized in cases involving losses of skin and subcutaneous tissue. In contradistinction to the handling of these cases during World War I, at our command were adequate supplies of penicillin, a more rapid system of evacuation, and facilities in evacuation hospitals comparable with those in civilian institutions.

Wounded soldiers on the average were received twelve to sixteen hours after injury. Some were seen as early as three hours and some at intervals up to four or five days after injury. Greater emphasis was placed on the appearance of the wound and of the surrounding structures than on the interval from the time of injury to the time of treatment. Many procedures have been carried out on healthy-appearing wounds two to four days old, with a successful result.

We never employed sulfanilamide or penicillin powder in any wounds which were to be closed. However, when wounds were to be left open, penicillin powder was lightly sprayed on all raw surfaces.

Penicillin was used routinely in all cases in doses varying from 20,000 to 40,000 units, administered every four hours for three to four days. Sometimes penicillin therapy was ordered continued while the patient was being transported back to the rear.

The development of the paper will follow rather closely the classification of wounds given on a foregoing page.

WOUNDS OF SOFT TISSUES

In this category are included wounds of the skin and subcutaneous tissues with or without involvement of the deep facial structures.

In cases in which the wound extended into the floor of the mouth or into the accessory nasal sinuses, drainage by routes explained under their proper section had to be carried out. Adequate but conservative débridement had to be assured, great care being taken to remove from the wound all foreign material, high explosive fragments, fragments of teeth and detached, displaced bone fragments. Irrigation with isotonic solution of sodium chloride was employed extensively before and during the operation. Obviously, none of these procedures was done in the presence of gross infection.

For suture material, no. 120 white cotton or 0000 chromic cat gut was used on subcutaneous tissue, fascia and muscle. Cotton sutures were not placed in the derma, but in the subcutaneous tissue. Six zero black silk was used on the skin.

Wounds Requiring Split Skin Grafts.—The use of split skin grafts was of value in treating those wounds involving loss of nasal cutaneous structures and of lateral orbital regions in which destruction of parts of both lids had occurred. These grafts were also applicable in those cases in which a sliding flap would produce distortion or would impede further, more definitive plastic procedures.

These were not used with the idea of producing a final cosmetic or functional result. Rather their use, assuming a "take" of the graft, provided an absolutely clean field that would make possible immediate further reconstruction when the patient arrived at his next stage of evacuation.

For final acceptable results the losses of nasal skin and subcutaneous tissue were repaired with either full thickness grafts or pedicle flaps. Since the nasal integument is fitted to and stretched over the underlying bony and cartilaginous framework, it does not lend itself to the making of sliding or rotation flaps. No pedicle flap operations which require delaying were done, nor should they be started when the patient remains in the hospital ten days or less. Full thickness grafts were not done at this stage of treatment, though looking back at the results obtained,

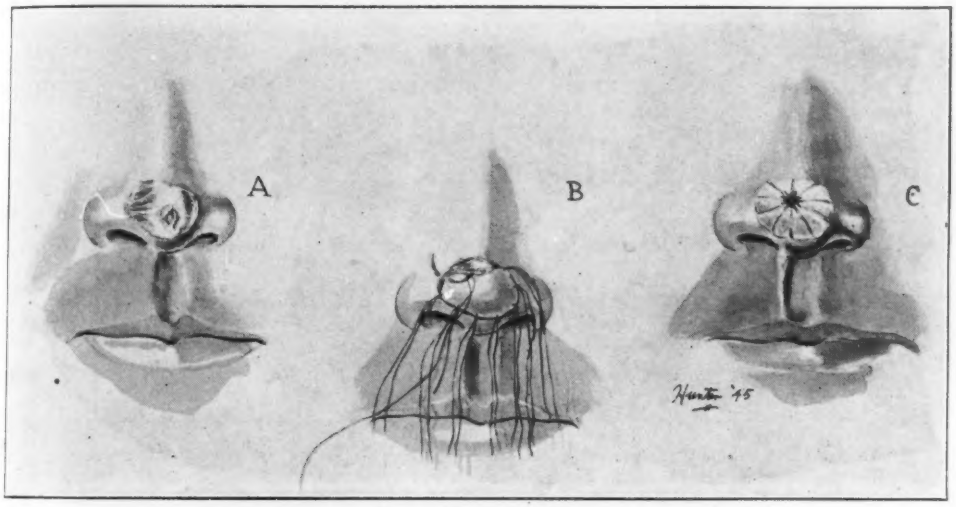


Fig. 1.—A perforating wound of the nasal tip destroying skin and subcutaneous tissue and part of the lower lateral cartilages: *A*, debrided wound. A small tear is seen in the center of the lower lateral cartilages, but the destruction was more pronounced than is seen. In similar cases, a bed for the reception of the graft could usually be built up from subcutaneous tissue or perichondrium. *B*, split skin graft taken from the medial aspect of the thigh being sutured in place, with the ends of the threads being left long. *C*, completed operation, showing the so-called bolus type of pressure dressing.

it is believed that their use was possible. For these two reasons the use of split skin grafts for losses of nasal skin was resorted to. It is felt that their application was sound when it was understood and when a technic was employed which gave satisfactory takes (fig. 1).

The rationale for using split skin grafts in large wounds of lateral orbital regions when both lids were involved was identical (fig. 2).

Wounds Requiring Flap Closures or Some Type of Plastic Procedure Other than Débridement and Suturing.—This group comprises

(*a*) wounds with relatively large losses of tissue and (*b*) wounds so situated that direct approximation, though possible, would produce distortion of facial features. The principle embodied in their closure was that of borrowing adjacent cutaneous and subcutaneous tissue and adjusting the resulting defects. Most frequently employed was the sliding and the rotation flap, which work on principles whose details are adequately illustrated by the accompanying drawings. Also of material aid were the advancement flap and use of Burow's triangles. Muçous membrane flaps to reconstruct the vermilion border, the Abbe-Estlander principle and the Bernard-Burow operation were found advantageous in partial losses of one or both lips. Extensive under-

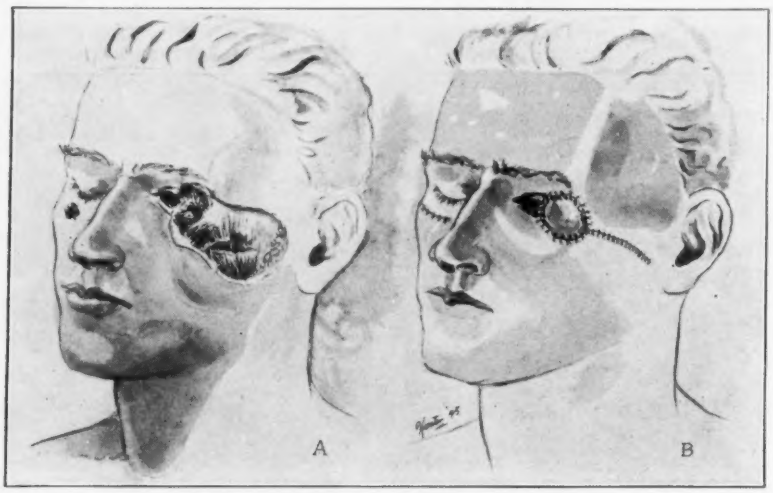


Fig. 2.—A perforating wound caused by a high explosive fragment that entered just below the center of the side of the right lower eyelid, traversed the nasal structure and the left orbit and made a large wound of exit involving the left sides of the upper and lower eyelids and the lateral orbital region. Both eyes were destroyed, and in the wound of exit the masseter muscle was partially divided. Only the details of the wound of exit were drawn to illustrate its particular treatment. *A* shows the debrided wound. In *B* the wound of entrance is seen closed by direct approximation after débridement. The larger wound of exit was partially closed by extensively undermining on the buccal side and moderately undermining on the temporal side. Closure was completed by the application of a split skin graft to the area in which eyelid losses had occurred. The same type of dressing was used here as shown in figure 1, but the bolus of cotton waste was omitted for the sake of clarity.

mining was found of value for large wounds occurring in the mental region or along the border of the mandible and on the neck. The skin of the neck is so easily mobilized and so abundant that wounds of rather extensive proportions on the lower part of the face can be sutured without tension after extensive undermining. In 1 case, in which there was a large gaping wound of the neck about the level of the hyoid bone, undermining was extended down to the clavicle.

Ace bandage pressure dressings were invariably used on these patients. The dressing was removed usually after three days, at which time alternate cutaneous sutures were removed. The remaining cutaneous sutures were removed on the fourth day. In no case did loss of a flap occur, and in no case was a gross infection observed. However, it must be borne in mind that the longest period during which any case was observed was about ten days, and usually the hospital stay extended over four or five days. Follow-up records and personal com-

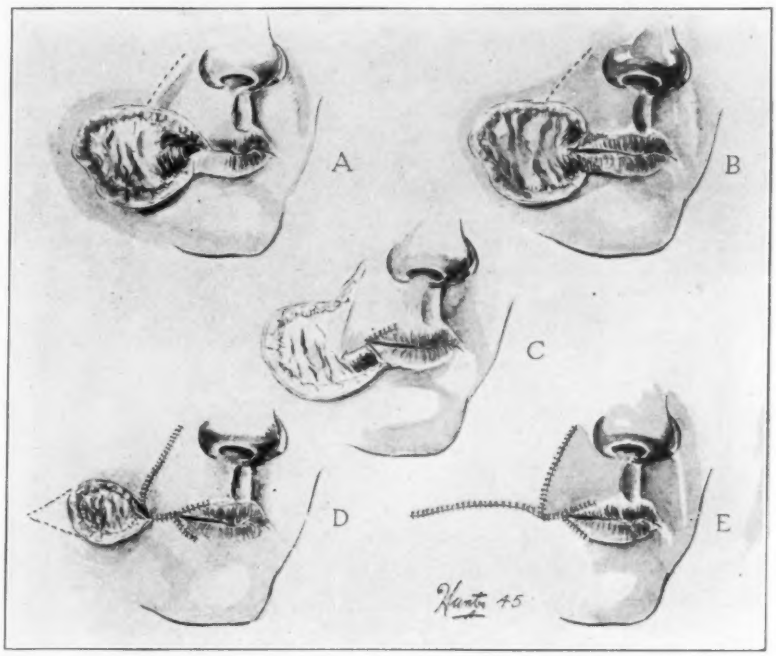
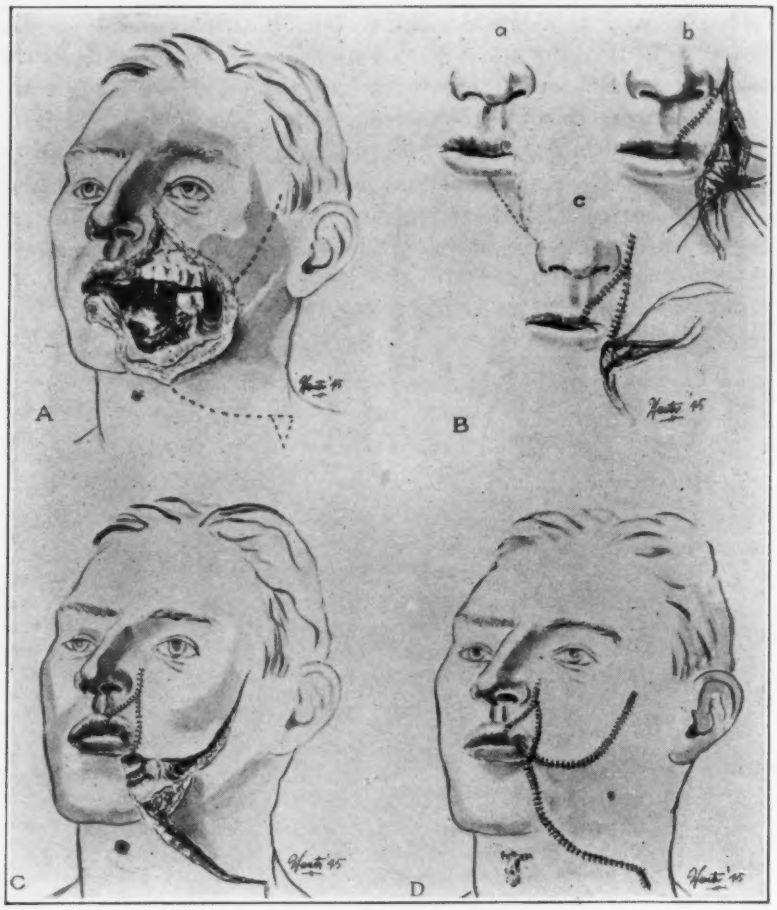


Fig. 3.—A perforating wound of the right buccal region involving only loss of skin and subcutaneous tissue: *A* shows the debrided wound. The dotted line indicates the nasolabial fold flap to be used. In *B* the distance from the midpoint of the philtrum to the left commissure was determined and projected on the right. The edges of those portions of the right sides of the upper and lower lips where losses had occurred were fixed at this point and debrided to conform with their normal shape as shown. The upper and lower lips were sutured together from the mucous membrane side to reform the commissure. *C*, mobilized nasolabial fold flap tacked into position, showing the resulting defect closed. *D*, closure of the lower end of the flap and the skin of the inferior margin of the wound, leaving a circular defect, which was closed by converting it into an ellipse and excising the triangle indicated by the dotted lines. *E*, completed closure.

munications with the patient in certain cases appear to bear out our clinical impression. The series of drawings shown in figures 3, 4, 5 and 6 serve to illustrate our procedures.

Wounds Requiring Only Débridement and Suturing.—There were many cases in which the wounds of soft tissues were such that after



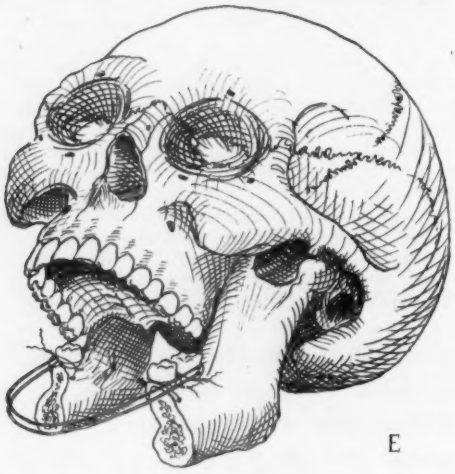


Figure 4

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débridement and moderate undermining the edges could be approximated without tension. Sometimes these wounds were extensive.

Our method of handling these wounds was as follows: First there was a thorough cleansing of the area surrounding the wound with soap solution and water. Then the wound itself was copiously irrigated with isotonic solution of sodium chloride. Mechanical removal of all foreign material followed with more saline irrigation, and then débridement of the deeper parts of the wound. In the event that muscles and fascia were involved, these structures were sutured with no. 120 white cotton. Thus the deeper wounds were converted to superficial ones before the skin edges were debrided. This was done for two reasons: First, it was believed that the toilet of the wound was much improved if the surgically incised skin edges did not bleed down into the depths of the wound, and second, it was found that débridement of the skin edges was greatly facilitated in a surgically built-up wound. Sometimes it was difficult to make a straight vertical incision through the skin in removing 2 to 3 mm. or less of the edge of the wound. But with use of the procedure just described and digital traction at the two extremities of the wound it was made easier. It was thought preferable to undermine the edges of all these wounds because there is an actual loss of tissue when débridement is completed. The extent of undermining naturally depended on the case.

FRACTURES OF THE FACIAL BONES

Mandible.—Mandibular fractures and their treatment have been a popular topic of discussion, especially in dental publications. Methods of wiring possessing this and that advantage have been advocated, but the essential procedure and the underlying basis remain the same, namely: some type of wiring with loops for the attachment of inter-

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EXPLANATION OF FIGURE 4

A perforating wound of the submental region with an extensive wound of exit destroying about one third of the left side of each of the lips, with loss of full thickness tissue of the cheek and loss of the mandible from the lower second molar region on the left to the first molar region on the right. *A* shows the debrided wound; dotted lines indicate incisions outlining flaps. In *B* (*a*) the incision represented by the dotted line is through and through and forms a triangular flap (Abbe-Estlander principle) which is to be rotated 180 degrees into the defect of the upper lip. In *B* (*b*) the previously described triangular flap has been sutured into the defect and a mobilized cheek flap has been advanced into position. Details of the suturing of the mucous membrane are shown, with the threads left long. *B* (*c*) shows the salvaging of the mucous membrane left from the wound of the floor of the mouth and the lining of the lower face and neck flap with it. *C*, mobilization of the lower face and neck flap. *D*, completed closure. *E*, details of fixation of the mandibular remnants. A double German silver arch wire, molded to conform with the shape of the mandibular arch, was held in position by stainless steel wires around the crevices of the teeth and, in addition, alveolar wires were placed on both sides as indicated in the drawing. This drawing was made by Atterbury.

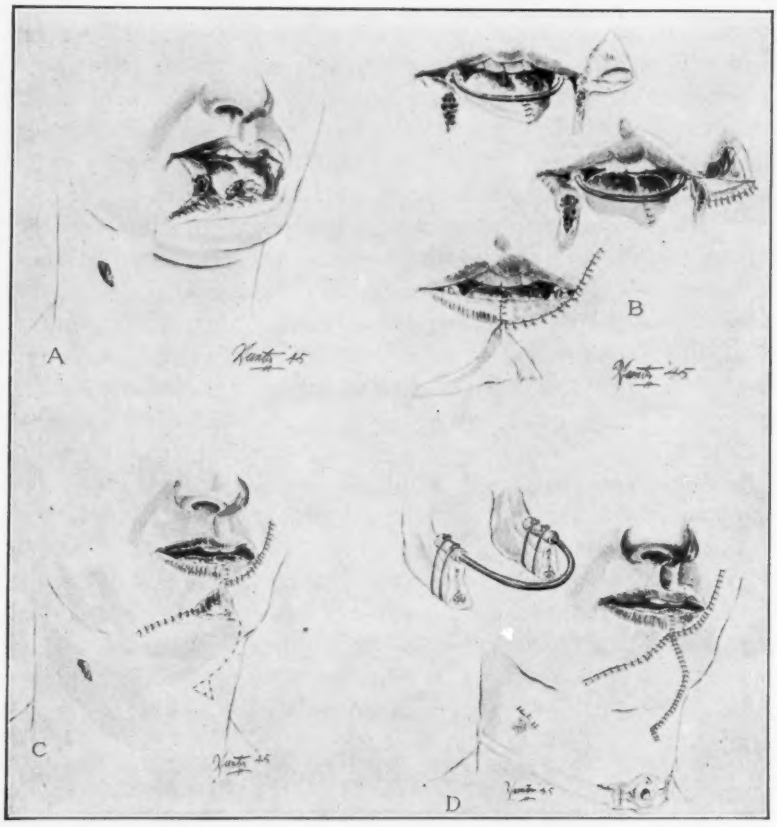

Fig. 5.—A perforating wound of the right side of the neck just below the mandible with an extensive wound of exit; all the lower lip except a small area on the right side was destroyed, with loss of the mandible from one second molar region to the other, where all teeth were missing. The repair employed the principle of the Bernard-Burow operation. *A* shows the debrided wound and the extent of tissue loss.

In *B* the upper drawing shows arch wire restoration of the mandibular arch and suture of the tongue. Repair of the injuries of the structures of the floor of the mouth was carried out by suture and is not shown in the drawing. A triangle of skin, subcutaneous tissue and muscle almost down to the mucous membrane is shown being excised. (A slight modification was used here in which the incision was made at the base of the triangle at an angle of about 45 degrees to the skin surface, the cut edge sloping downward; and a small amount of muscle was left instead of excising down to the mucous membrane. It was felt that by these two principles rotundity of the section of the lower lip to be reconstructed was improved.) The middle drawing shows the mucous membrane remaining after excision of the previously mentioned triangle. This membrane is reflected to the base of the triangle, trimmed to the lateral conformation of the lip and sutured into place. The lower drawing shows the thus constructed left portion of the lower lip shifted toward the midline and sutured to the right remnant of the lower lip. The resulting defect is shown. In *C* part of the defect is seen sutured, and the dotted lines indicate the incision for the proposed sliding flap. The triangular dotted area is excised to prevent buckling when the flap is rotated into position (use of Burow's triangles). In *D* the upper drawing shows the details of the fixation of the mandibular remnants. A brass arch wire having considerable stability was held in place by circumferential wires on each side. The extremities of the arch wire that rested on the gingivae were covered with rubber plasma tubing. The lower drawing shows the completed closure. Note the drainage of the wound of entrance.

This work was done with Samuel A. Leishear, D.D.S., Washington, D. C.

maxillary elastics to fix the teeth in occlusion normal for that case. This applies to cases in which there is a sufficient complement of teeth and no appreciable loss of bony tissue. However, these cases were few and far between in this series. The Stout multiple loop wiring was frequently used, but it was agreed that any of the many methods were equally acceptable, such as, the Ivy loop, the Ridson, the Kazanjian button and numerous others.

The use of arch wires to restore the mandibular arch in cases with large losses of bone was found most advantageous. These have been applied in cases in which most of the mandibular teeth were missing and in 1 case in which no mandibular teeth remained after injury (fig. 5 *B* and *D*). A simple but effective clasp was used in those cases in which one molar tooth was retained and several teeth mesial to it on the same side of the arch were lost (fig. 7).

In addition, to increase further the stability of arch wires, circumferential wiring was extensively used (figs. 5 *D* and 7). It was surprising at times how much fixation was obtained by this procedure.

The objective in these cases of severe injury with large losses of bone was twofold: first, to restore as nearly as possible the mandibular arch, and second, to effect a safe evacuation of the patient to a center where a more permanent type of retention prosthesis could be made, preparatory to bone grafting at a later stage in the treatment.

Of the more unusual methods, direct bone wiring has on occasion been used. Alveolar wiring has also been used to stabilize arch wires (fig. 4 *E*). In 1 case in which there was a vertical split of the ramus with much displacement, a circumferential wire was passed in the manner in which such a wire is used in ramus osteotomy, using the Ivy pedicle needle. The ends of the wire were left long and protruding from the wound. It was felt that in the later stages of evacuation this wire could be tightened and hence a satisfactory reduction obtained. In this case the teeth were fixed in occlusion with intermaxillary elastics (fig. 8).

Much more could be written on these cases, but it would only be a restatement of well known principles in common use. Emphasis is placed on the use of arch wires and circumferential wires in stabilizing parts, restoring the mandibular arch and, in general, preparing patients with severely traumatized mandibles for evacuation.

Maxilla.—In each case in which there was a penetrating wound of the maxillary sinus, a demonstrable fracture of the maxilla was almost always present. Often the high explosive fragments were small and likewise the wounds made by them; hence the disturbance of occlusion was nil. Surgical treatment was restricted to the antrums in these instances. Associated with zygomatic fractures were fractures of the maxilla, and likewise some of these required no fixation of the tooth-

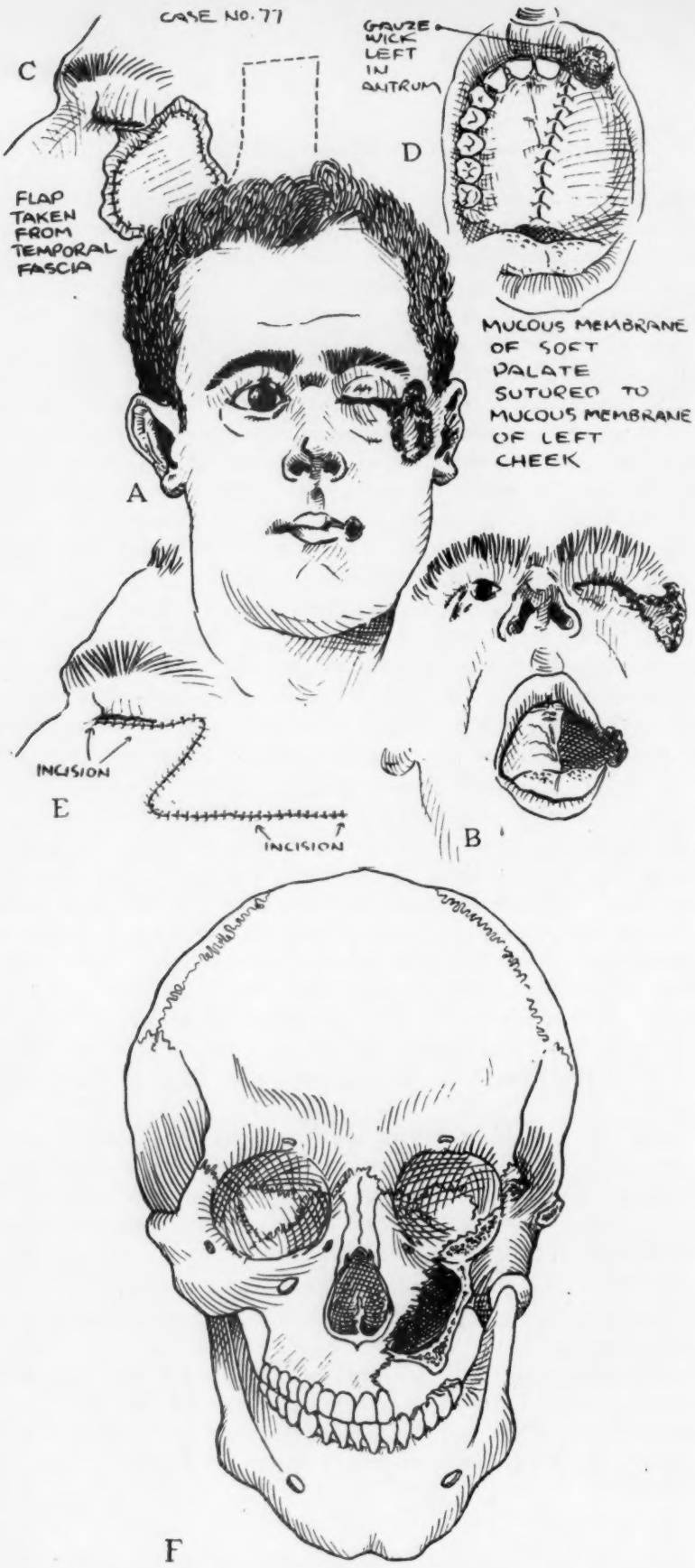

Figure 6

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bearing portion of the maxillary bone. Thus it is explained why the actual number of fractures of the maxilla requiring some form of interdental fixation totaled only 32 against an aggregate number of 52 maxillary fractures.

One of the striking observations concerning these injuries was that a high velocity fragment could shear off a large segment of one maxilla while the other side remained intact and in good position (fig. 6*F*).

In the more simple cases requiring some type of fixation, arch wires were used to maintain segments that were displaced either palatally or buccally, combined with the use of intermaxillary elastics. In cases in which the damage was more severe and the fragments had greater mobility, stainless steel wires were attached to the arch wires and brought out through the mucobuccal fold and so through the cheek, to be hooked to attachments embedded in plaster head caps.

Malar Bone.—Fractures of the malar bone were treated by elevating the depressed segments into as nearly normal position as possible. The methods included the Gillies approach, intraoral methods, external use of a tenaculum forceps and even use of the wound as a direct approach to the fracture. On several occasions direct bone wiring was used to maintain position.

In 1 case that was interesting, the zygomatic arch was found splintered and crushed but the fragments remained fairly well confined to a straight line and attached. The injury was due to a grooving bullet wound. The temporal fascia above and the masseteric fascia below were uninjured. Therefore, two parallel incisions were made, one above and one below the zygomatic arch. The cut edges were then sutured together with no. 120 white cotton in the form of a tube. This was done with the idea of forming a guide for the osteogenesis of a new zygomatic arch (fig. 9).

Nasal Bones.—Most fractures of the nasal bones without great loss of bony structure could be treated in the usual manner. First, the septum was alined with Asch's forceps, next the nasal bones were

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EXPLANATION OF FIGURE 6

A rifle bullet perforated the lower lip at the left commissure, shearing off most of the left maxilla from the third to the eighth tooth. The anterolateral wall of the left antrum, the lateral third of the bony orbit and the left eye were destroyed. There was a large wound of exit in the left temporofacial region. The right maxilla was apparently intact and in good position. The skin and subcutaneous tissue of the lateral third of the left side of the lower lid were lost. The left side of the face up to the orbit was likened to a hollow shell. The antrum was cleaned out and the face treated as shown. *A* shows the wound of entrance and the exit before débridement. *B* shows the palatal loss. In *C* a flap of temporal fascia has been mobilized and sutured over the bony defects to support flaps for the closure of the defects of skin and subcutaneous tissue. *D* shows suture of the buccal mucous membrane and subcutaneous tissue flap to the palatal mucous membrane. A larger defect than shown was left anteriorly, and the antrum was drained into the mouth as indicated. *E*, completed closure. *F*, drawing by Atterbury of the amount of bony loss sustained.

elevated with a blunt elevator, and finally the external contour was manually reestablished. Often the fractures were so comminuted that intranasal packing was necessary to maintain the fragments in position.

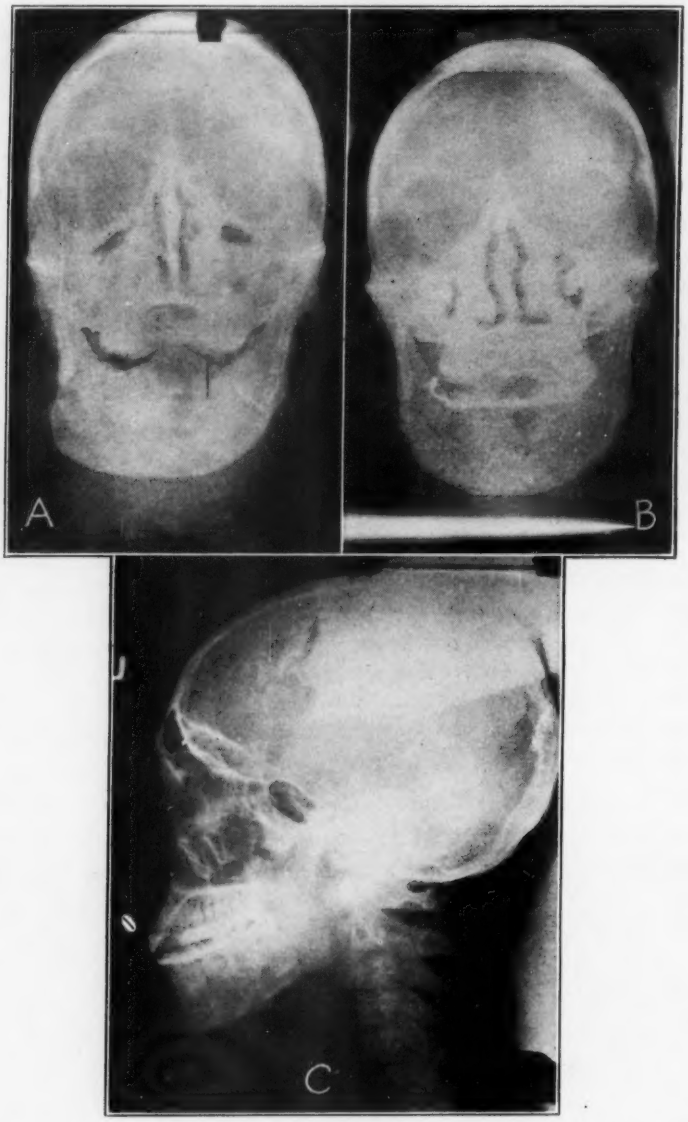

Fig. 7.—*A* shows a compound comminuted fracture of the right mandibular body and ramus with loss of the twelfth and thirteenth teeth. *B* and *C*, the reduction obtained.

For this we used finger cots which had been previously partially filled with ½ inch (12 mm.) nasal packing and well lubricated with petrolatum or other suitable ointment. Incidentally, here it is well to point

out the importance of packing the nasal cavity when the mucous membrane has been perforated. This is done in order to prevent the formation of synechiae. These packs were left in place for five days and then were removed and replaced. When the patient was evacuated to the

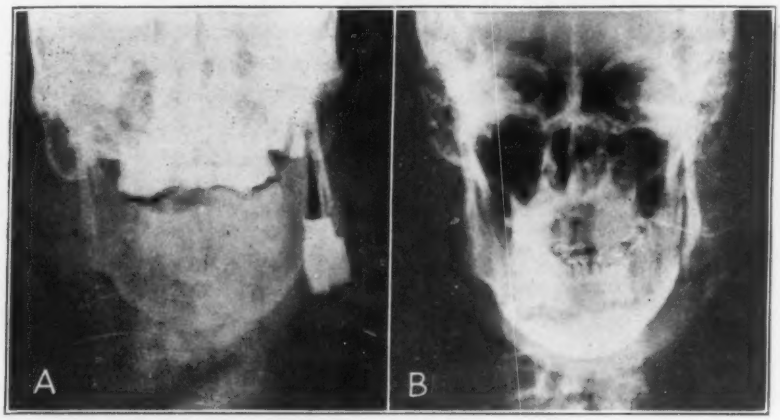

Fig. 8.—*A* shows a high explosive fragment wedged in a vertical split of the ramus; *B*, the reduction obtained by horizontal circumferential wire.

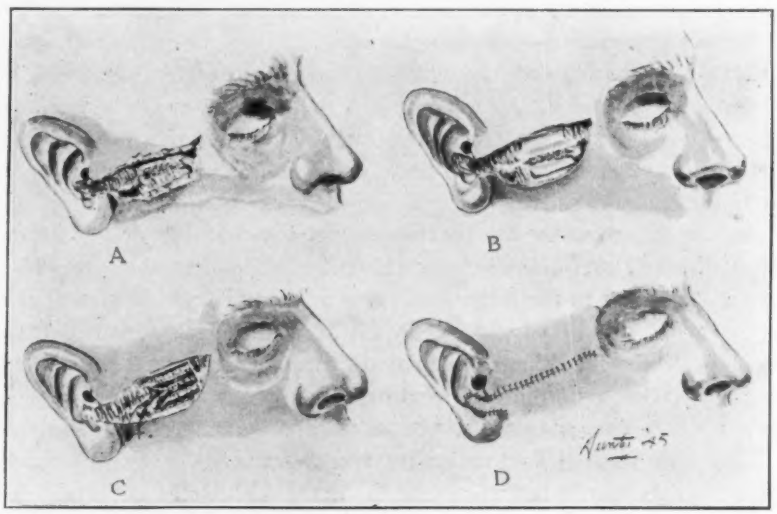

Fig. 9.—A grooving bullet wound of the right side of the face and ear, with multiple chip fracture of the zygoma. There was also a fracture of the right mandibular ramus, treated by Stout multiple loop wiring and intermaxillary elastics. The zygomatic fracture was treated as shown: *A*, wound before débridement. *B*, mobilization of flaps of temporal fascia above and masseteric fascia below for formation of a tube. *C*, fascial tube being completed; dotted lines at the inferior border of the incision near the lobule indicate incisions for a small advancement flap to replace the lost skin and subcutaneous tissue of the concha. *D*, completed closure.

rear, daily care was continued until healing of the mucous membrane was complete.

One of the procedures found most useful in these cases was a nasal splint made of plaster of paris bandage. It was made roughly triangular with rounded angles and an extension for stabilization on the forehead. Six to eight layers of ordinary plaster bandage were used with a thin layer of gauze for a lining. It was placed on the nose wet and allowed to harden in position, digital pressure being used to insure accurate conformation to the nasal pyramid. These splints fitted so well that if they were removed after the plaster had set, they could hardly be replaced. An adaptation of this type of splint was used as a dressing for some nasal lacerations, especially in those cases in which some procedure was carried out on the columella. By embedding a hairpin in the plaster and putting a small extension on the lower end of the splint, a pressure dressing can be held in place over the columella.

Frontal Bone.—The fractures of the frontal bone seen were chiefly those involving the frontal sinuses. Others were minor fractures of the supraorbital ridges or depressed fractures without severe cerebral damage, which required only elevation to prevent deformity. The majority of wounds in this region were treated by neurosurgeons.

WOUNDS INVOLVING ACCESSORY NASAL SINUSES

Maxillary Sinuses.—Wounds in which a high explosive fragment penetrated or perforated the maxillary sinus had two requisites for their treatment. First, the antrum had to be cleared of all bone fragments, in-driven tissue, teeth and high explosive fragments. The antral mucous membrane has extremely poor tolerance for foreign bodies and responds by a constant attempt of the cilia to eliminate them, with a resultant abnormality of function which favors infection. Second, drainage should preferably be established by the intranasal route. However, in reference to the latter statement it must be admitted that there were a few cases in which the oroantral wound was so large that it could not be closed. Then this route of drainage was used but with the realization that a permanent oroantral fistula was unavoidably being created. This necessitated further operative care at a later date (fig. 6*D*).

The best method for removing fragments and generally cleaning out the antrum includes an approach of the Caldwell-Luc type. This approach was made in all cases involving the antrum in which the interior of the antrum could not be visualized and cleaned out through the external wound of the face or through an oral wound. In these cases, after the interior of the maxillary sinus was adequately cared for, the external wound or the oral wound, as the case might be, was closed and an intranasal antrotomy performed.

Only the surgical anatomic approach of the Caldwell-Luc operation was employed. The antral mucous membrane was not removed in toto, only that part of it visibly destroyed being sacrificed. Petrolatum gauze packing was placed in the antrum to control bleeding, and its end was brought out through the nasoantral window. It was removed within twenty-four to forty-eight hours.

Often the course of fragments did not indicate exactly where the sinus had been penetrated or where the high explosive fragment was lodged. The locations of these findings were ascertained by accurate diagnostic roentgenography.

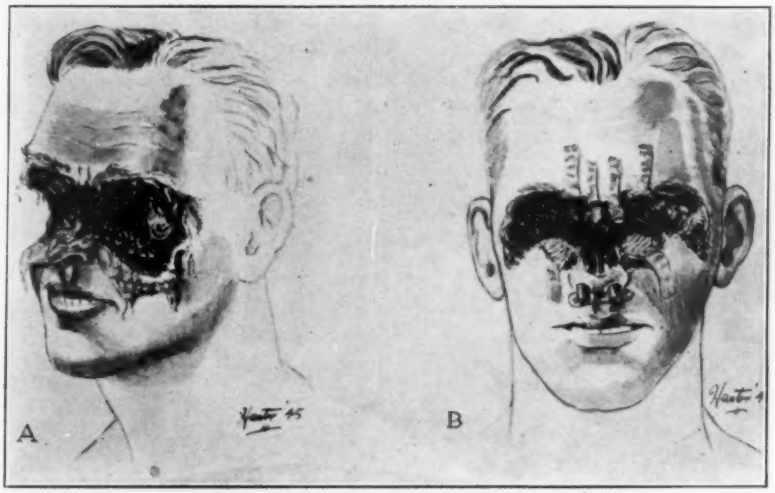

Fig. 10.—A perforating wound of the right zygomatic area with the fragment traversing both orbits, destroying both eyes, the anterior half of both orbits, the upper half of the maxilla, both nasal bones, portions of the turbinates and most of the septum. The frontal, ethmoid and maxillary sinuses of both sides were involved. The intervening soft tissues were lost as shown. *A* shows the wound before treatment. In *B* all the involved sinuses have been cleaned out and packed with ½ inch gauze packing, the ends of which are brought out over the edges of the wound. A minimum of débridement has been done, and only sufficient suturing to tack the flaps to the subcutaneous tissue. Rubber tubes are inserted through the nares, extending back into the nasopharynx. They are breathing tubes, and they prevent the nasal airways from being occluded with scar tissue. They are transfixed through the columella with a sterile safety pin.

There was a group of cases, 6 in all, in which the maxillary, frontal and ethmoid sinuses were involved in an extensive facial wound. These wounds were designated as midsegment injuries, and drainage of the sinuses was carried out externally (fig. 10).

Frontal Sinuses.—When a wound involved a frontal sinus and foreign material was present, the removal of this material was deemed imperative. When the frontal sinus was approached surgically, a supraorbital incision was made, the sinus cleaned out and a small petro-

latum gauze wick inserted in the sinus and brought out through one angle of the incision, which was closed up to this point. This wick was used for drainage, and external drainage was selected for the reason that it was preferable to do a simple procedure rather than to carry out a somewhat complicated intranasal operation that would add to the trauma by enlarging the nasofrontal duct for insertion of a tube to provide intranasal drainage. The wick was removed three to four days after operation, and the wounds invariably looked good and the frontal sinuses were not infected.

Ethmoid Sinuses.—The ethmoid sinuses were involved only in cases of severe midsegment injuries. In these cases the ethmoid labyrinths were curetted through the wounds and packed with petrolatum gauze (fig. 10).

PENETRATING WOUNDS CONTAINING HIGH EXPLOSIVE FRAGMENTS WHICH REQUIRED OPERATIVE APPROACHES FOR THEIR REMOVAL

This type of injury was treated by operations which were at times interesting and instructive. Fragments of almost unbelievable sizes and shapes entered at various sites on the face and neck and lodged in most inaccessible places. At times the damage wrought by a missile in expending its momentum was terrific, at other times slight. Rifle bullets take on a tumbling motion when they strike at certain angles, and frequently when one is removed its nose is pointing toward the wound of entrance or in a direction different from that at the time of entry.

In the removal of fragments from the deeper regions of the neck, the approach was anatomic, and dissections were carried out, with liberal incisions being used. The suprahyoid incisions were made horizontally, the hyoid bone being used as a primary landmark. Fragments in the deeper structures of the neck below the hyoid bone and lateral to the midline were commonly approached by an incision along the anterior margin of the sternocleidomastoid muscle. If a fragment was to be removed by making an incision at the posterior border of the sternocleidomastoid muscle, it was found wise to start 1 cm. posterior to the palpable posterior border of that muscle; thus one avoided the cervical cutaneous plexus which wraps around the border of this muscle at the level of the thyroid cartilage. Sometimes a great deal of time was spent in search of a fragment when the exposure was adequate and the fragment was not more than a half centimeter away from the exploring instrument and of relatively small size. To obviate this, the following method of removing such fragments was employed. A thorough study of the case was made and the anatomic situation and the method of approach decided on. The incisions were made, and the approximate location was exposed; a moderate search was then made in all directions,

and if the fragment was not readily recoverable, two silver brain clips were placed in the depths of the wound, 1 cm. apart. A sterile dressing was then placed over the wound, and the patient was taken to the x-ray department for anteroposterior and lateral roentgenography of the neck. The fragment was then located with reference to the two brain clips.

Operative procedures for the removal of fragments from the deeper structures of the face were at times difficult.

One patient had a 30 caliber machine gun bullet just lateral to the anterior margin of the foramen magnum on the right. The wound of entrance was a hole 1 cm. in diameter in the left side of the lower lip, and the missile had destroyed the lower left lateral and central incisors. On direct examination there was no visible damage of the palate or other intraoral structures. Other than a certain amount of drowsiness there were no symptoms. The method chosen for the

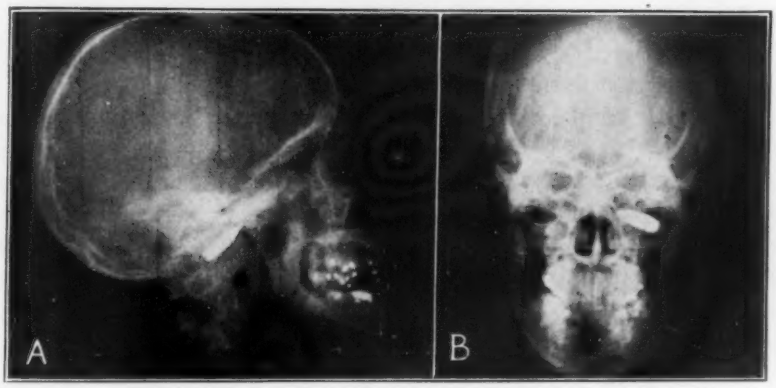

Fig. 11.—*A,* lateral roentgenogram of a skull showing a rifle bullet. *B,* posterior-anterior projection of the skull. Note the direction in which the bullet is pointing.

removal of the bullet was that of dividing the right side of the soft palate and exposing and enlarging the wound of the posterior pharyngeal wall, which oddly enough was above the level of the soft palate. This was done, and by blunt dissection from this point the bullet was located and removed. The internal carotid artery was palpable in the depth of the wound as this was explored with a blunt probe, and while the bullet lay adjacent to it, the artery itself remained undamaged. The palatal incision and the wound of entrance in the left side of the lower lip were closed. The postoperative course was characterized by absence of symptoms, and the highest recorded temperature was 99.6 F. On the fifth postoperative day the patient was evacuated with the palatal sutures still in place and the wound healing well (fig. 11).

Fragments were frequently found in the pterygopalatine fossa. To remove them, a horizontal mucobuccal fold incision extending from the upper first molar tooth as far posteriorly as the tuberosity of the maxilla was used. Blunt dissection upward and posteriorly and thence into the

pterygopalatine fossa followed. The room afforded by such an approach was surprising.

In 1 case a fragment entered the left cheek and lodged medial to and just below the neck of the right mandibular condyle. It was removed by making a curved incision, convexity downward, 1 cm. below the right angle of the mandible and then by blunt dissection following the structures upward on the internal aspect of the ramus until the fragment was located.

In another case there was a large fragment in the left side of the nose at the level of the midportion of the middle turbinate. It had entered the left cheek and traversed the left antrum and lodged in this position. It was too large to be removed through the naris; hence the columella was detached at its base and reflected up to the tip of the nose, and the quadrilateral cartilage was incised at its attachment to the vomer. The cartilage was retracted to the right and the space now provided easy removal of the fragment. The cartilage sprang back into position, and the columella was sutured into place.

WOUNDS INVOLVING THE LARYNX, THE TRACHEA OR THE PHARYNX AND REQUIRING TRACHEOTOMY

The number of these wounds was small, since a percentage of patients thus injured did not reach evacuation hospitals and some patients were received for whom tracheotomies had already been performed. The chief indication was to assure the safe transportation of patients who had damaged airways.

When the larynx was lacerated or partly destroyed, the procedure was débridement of the wound, closure of the skin and subcutaneous tissue, and tracheotomy. No operative procedure was carried out on the patients themselves.

The one bayonet wound observed fell into this category. There was a small stab wound of the left side of the neck with marked subcutaneous emphysema, little hemorrhage and only slight respiratory obstruction. However, on the lateral cervical roentgenogram there was definite evidence of laryngeal damage. Direct laryngoscopy revealed a large hematoma of the left piriform sinus. The treatment consisted of tracheotomy, débridement and closure of the neck wound.

The patients with these wounds were handled on the principle that if there was a reasonable doubt that they might not be transportable because of respiratory obstruction, tracheotomy should not be withheld.

WOUNDS INVOLVING THE ORBITAL STRUCTURES

In this group of cases we were concerned chiefly with repair of eyelids and treatment of adjacent damaged structures. To care for ocular injuries, ophthalmologists were called in consultation when they were available. If vision was present, no attempt was made to remove fragments from the depths of the orbit. However, when enucleation was performed, intraorbital fragments were removed if possible.

In repair of eyelids the same principles as were described under the first heading of this paper were used.

INJURIES INVOLVING GREAT VESSELS OF THE NECK THAT REQUIRED LIGATION

Only one case fell into this category:

A consultation was asked by a surgeon who, in exploring a wound of the lower left side of the neck with an intrathoracic penetration, found a large hematoma. When it was removed, profuse hemorrhage resulted. The tear was found in the internal jugular vein, which was ligated. By horizontal division of the clavicular attachment of the sternocleidomastoid muscle and reflecting this structure upward, excellent exposure was obtained.

PENETRATING WOUNDS OF THE NECK WITH LARGE HEMATOMAS, SMALL WOUNDS OF ENTRANCE AND SMALL HIGH EXPLOSIVE FRAGMENTS

While the total number of wounds of this type was small, yet they constituted a definite entity.

The patient is usually in good shape when seen, with a tiny wound of entrance on one side of the neck and a large hematoma on the same side. Roentgen examination reveals a fragment about two to three times the size of the head of a common pin lying somewhere in the deep structures of the neck. Experience has shown that the removal of such a fragment is improbable. It is felt that in such cases the patient will do satisfactorily without the benefit of an exploratory operation, since the hemorrhage is controlled by clot formation and by tissue restriction acting as pressure. It is believed that the absorption of a large hematoma is less of a chore for the body than recovering from an explanatory dissection of the neck.

A case closely associated with this group was observed in which there was the typical small wound of entrance, but a small hematoma, and the fragment, according to roentgenologic interpretation, was lying in the esophagus. There was a history of moderate hemoptysis. It was decided in this case to do nothing. The patient was treated with penicillin and observed for four days and was then evacuated, afebrile and without symptoms.

Another case was seen in which there was the typical wound of entrance with hematoma. In addition, over the tumor mass a palpable thrill could be made out, and the auscultatory findings were those of an arteriovenous fistula. The patient was seen sixteen hours after injury, was observed four days and then was evacuated.

MULTIPLE PENETRATING WOUNDS OF THE FACE, WITH NUMEROUS SMALL LACERATIONS FROM PRIMARY OR SECONDARY HIGH EXPLOSIVE FRAGMENTS, AND BLAST INJURIES OF THE FACE WITH MYRIADS OF SMALL FRAGMENTS WHICH WERE SUPERFICIAL

Cases of this type were common and presented a problem as to treatment. Explosion at close range produced typical-appearing powder

burns with the addition of numerous high explosive fragments. The commonest secondary fragments seen were those objects to which a high explosive had imparted its force and motion, namely, glass or wood. Fragments of the latter sort were found particularly in those injured in houses where the enemy had left delayed action mines. Embedded in the face of 1 patient were numerous particles of teeth belonging to another person.

Powder burns were seen in which one complete side of the face was homogeneously black, and in the same patient were numerous high explosive fragments of minute size. The face was scrubbed with sterile soap solution and a brush for almost an hour. The fragments were removed with a no. 11 knife blade or sometimes with a small eye curet, and the larger nicks were frequently sutured.

On occasion, even the skin-grafting knife was used to remove superficial layers of skin that were so tattooed that they could not be treated otherwise. After the cleansing process was completed, the areas were treated as burns.

When there were numerous lacerations, as in the cases with flying glass as the secondary fragments, the problem arose of debriding and suturing and removing fragments from perhaps a hundred small wounds. This was obviously impracticable if not impossible. Removal of all fragments was attempted, but only the larger wounds were debrided and sutured. The smaller wounds were irrigated with isotonic solution of sodium chloride and cleaned up as well as possible. These patients were then treated as those with burns. When the affected areas were dressed three to four days later, the wounds looked good and were clean, and those not sutured were amenable to secondary closure.

FACIAL WOUNDS WITH PERIPHERAL FACIAL PARALYSIS; WOUNDS INVOLVING THE PAROTID GLAND OR DUCT

These classes are grouped together because all the patients who presented evidence of facial paralysis had associated damage of the parotid gland. That the facial nerve is well protected was borne out by the fact that of 20 patients having wounds of the parotid glands, only 11 had evidence of damage of the facial nerve.

Wounds in this category were interesting because of the inability to do much about them surgically. With a large wound of the parotid region, the distal segments of peripheral branches of the facial nerve could not be found. Direct suture (provided too great a loss had not occurred) to the proximal stump, which could have been found, was contemplated or at least suture tagging with the possibility in mind of future nerve grafting or anastomosis.

There was a patient who clinically presented a peripheral type of facial paralysis. A rifle bullet had entered at the left mastoid process, destroying part

of the auricle and producing a large wound of exit on the same cheek. On exploration of the wound a partially divided facial nerve trunk was found at the posterior part of the deep surface of the parotid gland, near the styloid process. This was sutured with 000000 black silk. Five days after this operation some of the function of the facial nerve had returned; hence a great part of the facial paralysis was due to reversible trauma and edema. The final outcome was not known, but the expectation was for complete recovery.

Wounds of the parotid gland were carefully explored for injury of the parotid duct, and if any had been found, an attempt to suture it would have been made. However, this was not done. When the gland itself had been lacerated or partially destroyed, the wound was extensively irrigated and a conservative débridement carried out. Closure was effected either by closing the parotid fascia, if this could be found, or by covering the defect with subcutaneous tissue of the skin flap. This was done with the realization that the gland might continue to secrete out, through section of some of the smaller branches of the duct system, into the subcutaneous tissue. There were times when the wounds were so extensive that the proximal extremity of the duct with a section of the gland was destroyed, which could be demonstrated by probing Stensen's duct. Wounds of this degree were likewise closed. A better method of treatment was not found.

BURNS OF THE FACE AND NECK

Most of the burns seen resulted either from fires in tanks that were hit, or from accidental explosions of gasoline stoves, which were in common use in this theater. However, the total number of burns in this series should not be taken as an index of their frequency, since most burns were treated by general surgeons.

The usual treatment of burns was first carried out, including administration of plasma, hematocrit determinations and general supportive therapy. All this was done before the original dressing was changed. Then when the patient was considered to be in satisfactory shape, he was taken to the operating room, and under aseptic conditions the face and neck were thoroughly scrubbed with sterile soap solution and water, gauze sponges being used and the process being usually continued for ten minutes. No débridement was done other than that accomplished by scrubbing and the use of ether to remove grease except to remove, with scissors, sheets of superficial layers of skin that were obviously destroyed and left hanging by shreds and not covering the denuded areas which they had normally protected. The burned area was then liberally covered with a sulfadiazine ointment, 5 per cent in a cold cream base. Over this was placed petrolatum gauze, and over this mechanics' cotton waste, all of which was fixed in place with several roller bandages. The whole was then encased in a pressure dressing consisting of a mask made of closely woven stockinet, in which there were holes for the eyes, nose and mouth.

The circumference of these holes was taped with ¼ inch (6.5 mm.) adhesive tape to prevent raveling of the stockinet. The patient was returned to the ward, and the general therapy of burns was continued until he was ready for evacuation. The dressing put on in the operating room was not changed.

ABSCESSES AND INFECTIONS OF THE FACE AND THE NECK REQUIRING INCISION AND DRAINAGE

Certainly these conditions were not remarkable but are entered for the sake of completeness. In 4 of the cases the infections resulted from war wounds with retained fragments that either were treated in forward aid stations or were not treated at all because the pateint did not report what he thought was too trivial. These fragments were all in the face, and one was treated by intraoral incision and removal, while the others were all pointing superficially. Two parapharyngeal abscesses were operated on, and they were seen in consultation with the Ear, Nose and Throat Service.

WOUNDS INVOLVING THE FLOOR OF THE MOUTH, THE TONGUE AND PHARYNGEAL STRUCTURES

These wounds were invariably associated with severe mandibular fractures and are segregated into a separate group to emphasize one point. As much repair as possible was carried out, and in all cases the wound was drained with a strip of petrolatum gauze inserted to the depth of the wound and brought out externally.

When lacerations of the tongue were present, they were sutured, and all soft tissue along the gingival margins was saved that could be saved. Only irreparably damaged teeth were sacrificed, and root fragments were surgically removed. The same sutures were used here, no. 120 white cotton on muscle and fascia and 000000 black silk on the mucous membrane.

WOUNDS OF THE SOFT AND THE HARD PALATE

Tears of the soft palate and of the mucous membrane of the hard palate were always sutured. On occasion it was necessary to use mucous membrane and subcutaneous tisssue of the cheek to aid in these closures (fig. 6 *D*). This was done only when there was a complete loss of part of the maxilla, including the ridge, and this procedure was carried out as an expedient to render later repair less difficult and to prevent the oral cavity and the maxillary sinus from being one and the same cavity.

ANESTHESIA

In this series of 421 cases there were 9 in which the surgical work was done with the patient under general anesthesia. The use of local

anesthesia was at times difficult and more trying to the operator, but it was thought to be a definite improvement in technic to be able to carry out long procedures without adding the risk of general anesthesia.

The patients were premedicated with morphine sulfate (¼ grain [16 mg.]), atropine sulfate (1/150 grain [0.43 mg.]) and seconal sodium (1½ grains [0.097 Gm.]) or pentobarbital sodium (1½ grains [0.097 Gm.]) from one-half to one hour before operation. Blocking of the second and third divisions of the trigeminal nerve was frequently employed. The peripheral branches of the trigeminal nerve were anesthetized by approaches directed to: the supraorbital, lacrimal, supratrochlear, infratrochlear, nasociliary and external nasal nerves of the first division: the infraorbital, zygomaticofacial, posterior superior alveolar (tuberosity) and nasopalatine (incisive branch) nerves of the second division: the inferior alveolar, auriculotemporal, deep temporal, buccal (long buccal), lingual and mental nerves of the third division. The cervical cutaneous nerve block was also frequently used. On occasion, infiltration and topical anesthesia were also employed and even peripheral blocks were used to reenforce deep blocks.

Obviously, a detailed discussion of the methods would be beyond the scope of this paper. However, a few general comments are pertinent. Two per cent procaine hydrochloride with 3 to 5 drops of 1:1,000 epinephrine hydrochloride to the ounce was used for all nerve blocks. For infiltration 0.5 or 1 per cent procaine hydrochloride with or without the addition of 3 drops to the ounce of 1:1,000 epinephrine hydrochloride was used, and this was not employed for long procedures. For topical anesthesia, 5 to 10 per cent cocaine hydrochloride or 2 per cent tetracaine hydrochloride ("pontocaine hydrochloride") on cotton pledgets was used intranasally.

For this type of work as many methods and approaches as possible should be learned, because the landmarks for any one approach may be destroyed. In general it may be said that anesthesia resulting from block of the gasserian ganglion was patchy, and it was found that a combination of deep and peripheral blocks was superior.

1124 North Highland Street.

A MODIFIED ENDAURAL INCISION WITH NERVE BLOCK ANESTHESIA FOR FENESTRATION AND MASTOIDECTOMY

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IN THE past five years, during which time we have performed over 1,300 fenestration operations at Wesley Memorial Hospital, Chicago, we have tried several variations of the original Lempert endaural incision.[1] At present we are using a modification which affords the following advantages:

1. A shorter postoperative course for complete healing.
2. Less tendency toward atresia of the meatus.
3. Less deformity.

In following our patients postoperatively, we have observed that with the old type of endaural incision, frequently the last place to heal was the relatively sharp posterior edge of the meatus and that atresia of the meatus occasionally made postoperative care more painful and difficult. In this new incision the triangular piece of skin originally discarded is now conserved; it is not removed but remains intact to form a smooth, rounded, already epithelized posterior edge of the newly formed cavity. Stratified squamous epithelium does not grow readily across a sharp edge of tissue such as occurs in the original endaural incision. This new technic avoids the relatively sharp raw posterior edge of the meatus which is not compatible with rapid epithelization, and at the same time it eliminates the formation of scar tissue at this point, which causes contracture and atresia of the meatus. This new technic provides adequate exposure for the fenestration operation and for the modified or the classic endaural radical mastoidectomy.

We have also modified the technic of injecting our local anesthetic so as to obtain more perfect local anesthesia. This permits a slighter, safer and less depressing premedication. Flagg recently stated that large doses of sedatives and hypnotics given preoperatively to supple-

1. Lempert, J.: Improvement of Hearing in Cases of Otosclerosis, Arch. Otolaryng. **28**:42 (July) 1938.

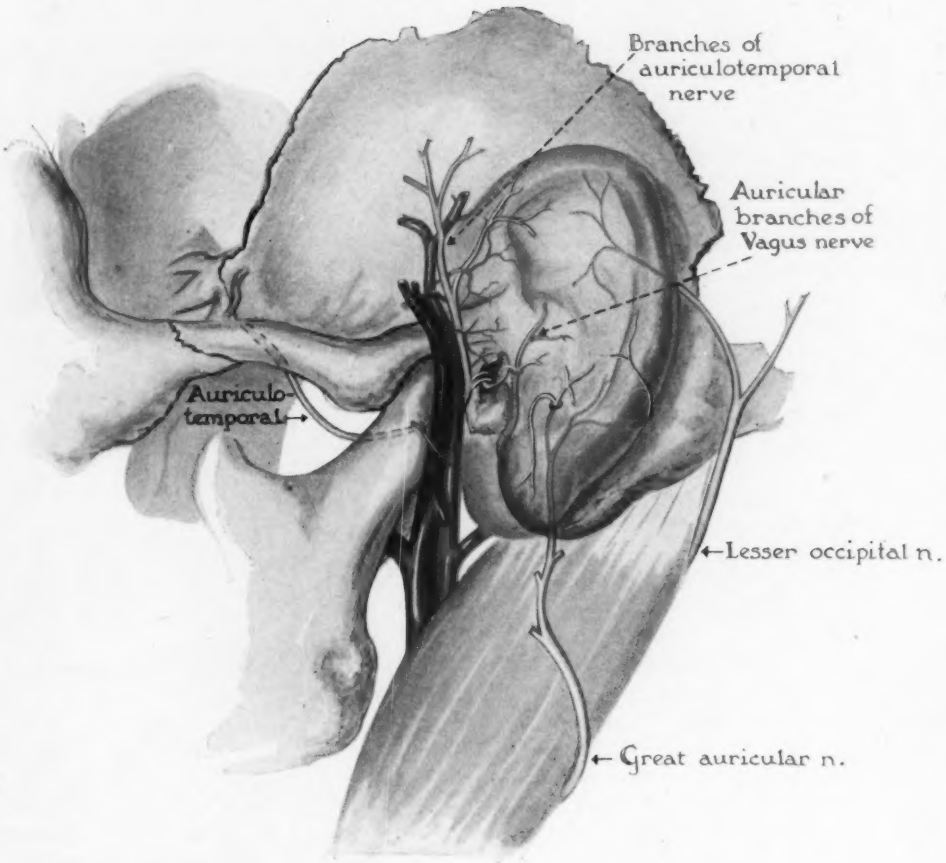

Fig. 1.—The innervation of the external ear (semitransparent) with relation to the temporal bone.

ment unsatisfactory local anesthesia can dangerously depress the patient.[2] The use of local anesthesia avoids the venous congestion and increased oozing which result from the use of general anesthetics.

PREMEDICATION

1. Three hours preoperatively, pentobarbital sodium, 0.2 Gm. (3 grains), is given orally.

2. One-half hour preoperatively, pentobarbital sodium, 0.2 Gm. (3 grains), is given orally, and morphine sulfate, 16 mg. (¼ grain), subcutaneously.

ANESTHESIA

Anesthesia is obtained by nerve block and local infiltration with a solution of "nupercaine hydrochloride" 1 : 1,500 to which has been added 0.5 cc. of epinephrine hydrochloride 1 : 1,000 per 30 cc. Satisfactory anesthesia should be obtained with a total injection of 25 to 30 cc. of the "nupercaine" solution. Small doses of sulfonamide compounds are used preoperatively and postoperatively to reduce the incidence of infection. Woods, in 1940, pointed out that procaine had a delayed inhibitory effect on the action of sulfanilamide. It is for this reason that a local anesthetic which does not contain para-aminobenzoic acid should be used.[3]

In reviewing the innervation of the external ear and canal, we find that it is derived from three sources: (1) the trigeminal nerve, through the auriculotemporal branch; (2) the vagus nerve, through the auricular branch; (3) the cervical plexus, through the great auricular nerve and the lesser occipital nerve[4] (fig. 1).

The auriculotemporal nerve provides innervation over two distributions: the anterior branches to the skin covering the front of the helix and the tragus; and two branches to the skin of the external auditory canal, which enter the canal anteriorly between the cartilaginous and bony portions, the upper branch sending a filament inward to the tympanic membrane. This upper branch has frequently been observed, during the fenestration operation, entering the meatus from the petrotympanic fissure. The auricular branch (the nerve of Arnold) of the vagus nerve arises from the jugular ganglion, passes through the temporal bone and emerges through the tympanomastoid fissure. It divides into two branches; one branch supplies the skin on the outer posterior surface of the auricle and the posterior part of the external auditory meatus, and the second branch joins the posterior auricular nerve. The great auricular nerve arises from the second and third cervical nerves. It ascends in the neck on the sternocleidomastoid muscle, under the skin and the platysma muscle. Its anterior branch is small and is distributed to the face and the parotid gland. The posterior branch supplies the skin over the mastoid process and the inner surface of the lower two thirds of the auricle, and a filament pierces the auricular cartilage and supplies the skin of the lower part of the concha and the lobule. The lesser occipital nerve arises from the second cervical nerve and ascends in the neck along the posterior border of the sternocleidomastoid muscle. It gives off a branch, occasionally

2. Flagg, P. J.: The Fenestration Operation: Major Hazard—the Anesthetic, editorial, Am. J. Surg. **72**:497 (Oct.) 1946.

3. Woods, D. D.: Relation of *p*-Aminobenzoic Acid to Mechanism of Action of Sulfanilamide, Brit. J. Exper. Path. **21**:74 (April) 1940.

4. Gray, H.: Anatomy of the Human Body, edited by W. H. Lewis, ed. 24, Philadelphia, Lea & Febiger, 1942.

derived from the greater occipital nerve, which supplies the skin of the inner surface of the upper third of the auricle.

To obtain local block anesthesia of the ear for the endaural incision, the injection is performed in the following four steps.

The first step begins with the injection of about 2 cc. of the "nupercaine" solution into the skin and subcutaneous tissues of the anterior wall of the canal at the junction of the bony and cartilaginous portions. This site may require reinjection if the duration of the operation is prolonged prior to the cutting of the skin flap in the fenestration operation. This injection anesthetizes the branches of the auriculotemporal nerve, one of which supplies the skin of the meatal wall down to the tympanic membrane and causes pain and discomfort to the patient during the preparation of the tympanomeatal skin flap.

In the second step one infiltrates endaurally the skin, subcutaneous tissue and periosteum of the inferior, posterior and superior edges of the bony rim of the meatus. This step anesthetizes the auricular branch of the vagus nerve.

In the third step one infiltrates in front of the helix, about 3 cm. above the external auditory canal, first under the skin and then down to the periosteum. This injection anesthetizes the upper branches of the auriculotemporal nerve.

In the fourth or last step the auricle is bent forward and the subcutaneous tissue at the junction of the auricle and the skull is infiltrated by a series of block injections along the entire length of the skin fold. This injection anesthetizes the great auricular nerve and the lesser occipital nerve. The great auricular nerve sends a branch through the auricular cartilage. It is this branch that supplies the skin of the lower and posterior part of the concha, and this area becomes quite painful if not anesthetized properly.

INCISION

The incision is made in two parts.

The first part is started on the superior wall of the canal (12 o'clock) at the junction of the bony and cartilaginous portions. It is extended posteriorly around the canal to the inferior wall (6 o'clock), care being taken to keep the incision at the same level in the canal. At this point the blade is directed outward, and the skin is cut about 0.5 cm. laterally toward the incisura. This increases the exposure of the inferior end of the operative field. The periosteum is then divided along the posterior edge of the bony part of the canal by long arclike sweeps of the knife point (fig. 2).

The second part of the incision is started at a right angle to the first part, on the superior wall of the canal (12 o'clock). It is first marked with a knife to avoid a jagged edge, by incising through the epidermis into the dermis. This incision extends out of the canal, between the tragus and the anterior crus of the helix, about 1.5 cm. along the anterior edge of the cartilage of the pinna (fig. 3). Avoid the tendency to extend this part of the incision anteriorly on the side of the face. It is important to keep close to the anterior edge of the cartilage of the pinna for two reasons: (1) so the fine scar in healing will approximate the normal crease and thus be almost indiscernible, and (2) to avoid severing the superficial temporal artery. This incision is continued deeper, and the periosteum is divided. The temporal fascia when encountered is incised. If the temporal muscle is low, as it is occasionally in male patients, it is freed from its fascial sheath and is pushed upward away from the field. Failing to accomplish this, one must excise a small piece of muscle.

The periosteum is then elevated posteriorly, superiorly and inferiorly over the mastoid process, sufficiently to provide adequate exposure. Anteriorly, above the meatus the periosteum is carefully elevated, exposing the root of the zygoma. The self-retaining retractor is then inserted, care being taken to place the elevated periosteum on the retractor blades (fig. 4).

After the operation has been completed and the packing has been inserted, two sutures are placed in the superior part of the incision anterior to the helix. The

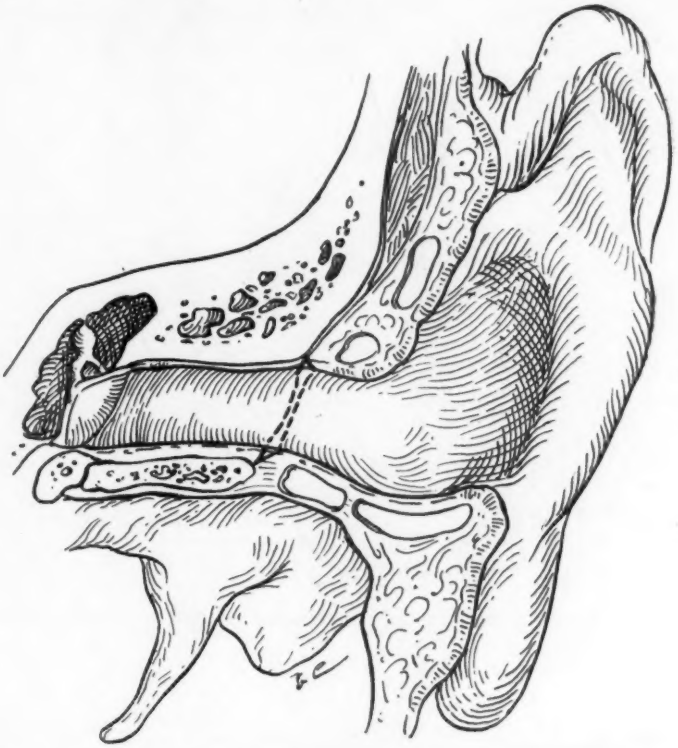

Fig. 2.—A vertical section through the external auditory canal showing the proper level of the first step of the incision, at the junction of the bony and cartilaginous portions of the canal.

posterior edge of the incision is tucked under the packing into the meatus. The sutures are removed on the sixth postoperative day, at the first dressing.

This incision heals without deformity of the concha, with a meatus sufficiently wide and protected from atresia, and with a scar which is practically invisible after six months.

MISTAKES THAT HAVE BEEN OBSERVED

In obtaining local anesthesia:

1. Failure to make injections into the anterior wall of the canal at the proper level. This does not place the anesthetic at the edge of the bony rim where the auriculotemporal nerve enters.

2. Injecting too deeply into the anterior wall. This may place the anesthetic in the posterior joint space or in the synovial cavity of the temporomandibular joint.

3. Failure to infiltrate first under the skin and then down to the periosteum.

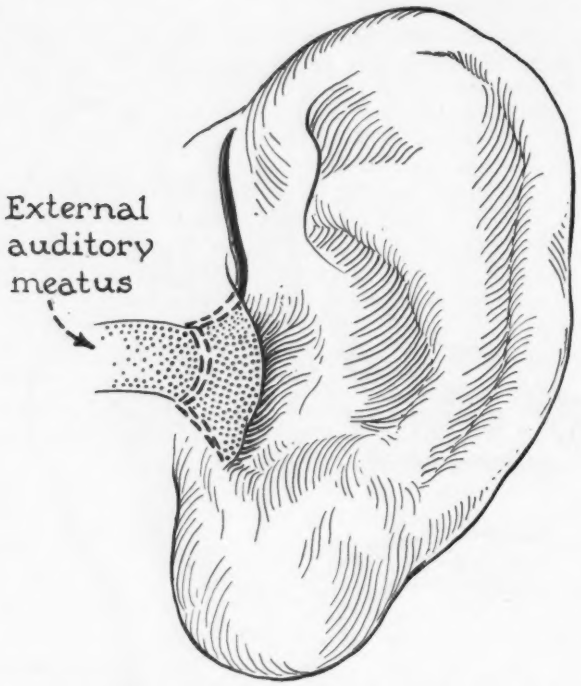

Fig. 3.—An oblique view of the ear showing the first and second steps of the incision completed.

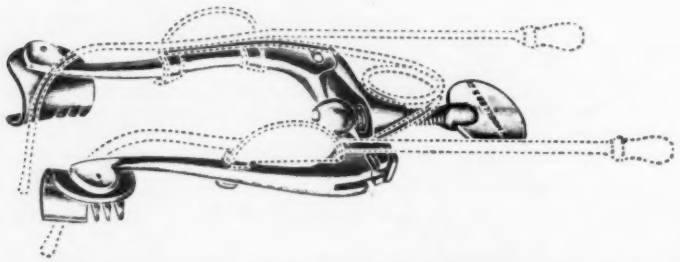

Fig. 4.—A self-retaining retractor used with the endaural incision. Broken lines show the position of the irrigation apparatus used in the fenestration operation.

In making the incision:

1. Failure to start the incision deep enough, at the proper level, that is, the junction of the bony and the cartilaginous canal, and the common tendency to work outward as the incision is made around the posterior wall.

2. Failure to divide the periosteum completely along the bony rim of the canal and anterior to the helix. This makes proper elevation of the periosteum impos-

sible. Adequate exposure is secured only by adequate and proper division and elevation of the periosteum.

3. Failure to mark the upper incision by incising just through the skin, resulting in the jagged edges which form a more conspicuous scar.

4. Failure to avoid the tendency of extending the upper incision anteriorly on the face

5. Failure at the conclusion of the operation to tuck the posterior edge of the incision into the meatus under the packing.

55 East Washington Street.

MAXILLOFACIAL FRACTURES—ONE HUNDRED AND FIFTY-SEVEN CASES

Experiences with a Hospital in Casablanca, Oran and Marseille

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EVACUATION of injured soldiers from forward areas may involve movement through aid stations, field, evacuation, station and general hospitals, and air and water transports. The missions of the various medical installations utilized in the chain of units for the transfer of casualties overlap in all or in part, and, more often than not, some units are by-passed. Thus, a patient may be flown directly from an aid station to a general hospital.

Great flexibility of purpose was achieved in the station hospital overseas. Generally patterned in function after post hospitals in the Zone of the Interior, station hospitals serviced ports and such large groups as Base Section Headquarters forces, combat unit staging and training areas, replacement depots, resting personnel centers and Air Corps units.

In the movement of the armed forces, the chain of events at times involved the replacement of an evacuation hospital by a station hospital, and this in turn by a general hospital.

Important technical factors influencing the stay of patients at the different medical installations were the incidence of casualties, the availability of transportation and the existing bed space on ships and planes moving to the United States. Captured prisoners of war presented a somewhat different problem, as it became necessary to provide for them relatively fixed station and general hospital plants, with prolonged stays assumed for guidance as to the extent of therapeutic procedures to be undertaken.

The authorized length of stay in the station and general hospitals for patients who were able to return to useful duties was varied frequently within thirty to one hundred and twenty day limits. Obviously, this fluctuating base line was calculated from current analyses of available hospital beds as related to anticipated admissions, evacuations and hospital movements. Patients requiring prolonged courses of treatment could expect early return to the United States.

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Presented with additions at the monthly staff conference of the Harlem Eye and Ear Hospital.

During and shortly after battle actions accompanied by incurrence of heavy casualties, station and general hospitals were crowded far beyond rated capacities, both by patients with acute needs and a backlog of patients being "held", awaiting movement home.

This brief sketch of the background of the treatment of the injured troops to be discussed in the following pages has been provided to emphasize factors restricting the decisions of surgeons overseas. Imagination must be given free reign in its endeavor to envision the handicaps of conducting courses of surgical treatment by refined civilian precedents under conditions which mocked every effort in that direction. The burdens of intolerable living conditions, strange and unpalatable diets, the tendency toward deterioration of morale and the hazardous environment did not lend any support toward encouragement of perfection in treatment of sick and wounded. An alert awareness, on the part of the command, of the presence of all these influences did much to combat their effects and produce a high standard of care of patients plus statistically impressive achievements.

INITIAL PHASE: CASABLANCA

Some one hundred and twenty days after invasion of North Africa, the 69th Station Hospital arrived at Casablanca, French Morocco, headquarters of the Atlantic Base Section. The staff disembarked on March 18, 1943, and active operation was realized ten days later.

During the six months of hospital function in Casablanca the majority of the casualties consisted of injuries incurred in troop movements and training activities. One spectacular mass admission highlighted the period, comprising a group of severely burned and badly battered Englishmen who were brought in as survivors of a bombed ship.

Maxillofacial work fell to the supervision of the chief of the Eye, Ear, Nose and Throat (hereafter referred to as EENT) Service in association with the dental oral surgeon. Fractures in this category were at a minimum in Casablanca. They may be briefly summarized as 7 fractures of mandibles and 2 fractures of noses resulting mainly from overexuberant fisticuffs; a maxillofacial deep depression type fracture occurring in a pilot in a crash landing when his face was crushed against a projecting instrument; an oromaxillary fistula following extraction of a tooth, and a depression deformity of the maxilla, the result of a blow, allowed to heal without reduction, which was causing pain, possibly because of inclusion of the infraorbital nerve in the scarred defect.

The patient who presented the last-named maxillary condition was marked for early return to the United States. The maxillonasal fracture of the pilot was immediately reduced through a regional laceration,

widened and stingily debrided; included facial tissues were released and a nasal antrotomy performed. Of the mandibular fractures, one was treated by open reduction with interosseous wiring. Employment of plaster headcaps was quickly discarded when it was found that adequate fixation could be more satisfactorily accomplished by other means. Major Donald Parsons, of the Dental Corps, carried the burden of the work of wiring teeth, preparing various types of prostheses, placing suitable elastic traction and the associated dental care, which was of an extremely tedious and meticulous nature.

Though the cases of this type handled in Casablanca were relatively few and not of battle type, a significant principle deduced at the time was that all new patients with fractures of this category should receive a full course of sulfathiazole therapy immediately on admission to the hospital. The speed in reduction of cellulitis in the region of the fracture was amazing. All patients appeared to thrive on "liquid jaw diets," as our dietitians chose to name them. On release of the fixation of the jaws, "soft jaw diets" were instituted. It was decided to limit the use of interosseous wiring and pin fixation to edentulous patients and to those in whom stabilization and good position could not be attained by interdental and intermaxillary wiring along with elastic traction. Fractures of the condylar neck were permitted to heal in position of self assumed realinement, following manual manipulation and application of elastic traction for maintenance of proper occlusion.

These early cases have been dwelt on at moderate length because they serve as a guide to the more rapid summary of the intricate and numerous varieties which followed later. The latter included many fractures that were of a compound, comminuted type, frequently complicated by extensive avulsion of tissues. Neither the Roger-Anderson pin sets designed for fractures of jaws nor penicillin was available to us until the fall of 1944.

At the time of our leaving Casablanca, records indicate, 282 patients had been admitted to the EENT Service of the hospital. On these, 178 surgical procedures had been performed, representing 28 per cent of the total number of surgical operations done. Additionally, 2,774 outpatient treatments had been given in the EENT clinic; 512 pairs of spectacles had been dispensed, and 585 consultations with regard to patients of other services had been accomplished.

ORAN INTERLUDE

Arriving at Oran, Algeria, headquarters of the Mediterranean Base Section, the 69th Station Hospital was the first to set up in a newly established hospital area, 8 kilometers east of the city. Three station hospitals, three general hospitals, a medical laboratory and miscellaneous accessory units were included in the area. Due to the invasions of Italy,

the increased speed of troop movements and more realistic training maneuvers specializing in amphibious undertakings, the volume of battle type admissions increased. Hospital ships were enabling casualties overflowing from Italy to reach us as early as three days after being wounded, during the height of the campaign.

Our station hospital functioned actively for about a year at the Oran Hospital Center, from September 1943 to September 1944.

Admissions to EENT wards in this period totaled 655. Of 201 operations performed in the service, 153 were either operations on ear, nose or throat, or maxillofacial procedures; 1,491 consultations were provided for other services. An active EENT clinic for outpatients rendered 6,221 treatments, including 101 minor surgical operations.

While in the Oran area, 69 maxillofacial and nasal fractures were recorded. The major cause of the fractures of 30 noses and 15 jaws amply reflected the vigorous existence and proclivities of the personnel marking time in Algeria. Treatment of fractured noses followed generally accepted precedents. Clearly evident at the time was the high incidence of infection of the upper respiratory tract in these patients when they were cared for in ward tents during the cold winter months. Erection of a few prefabricated huts afforded better shelter, with a sharp fall in the frequency of this complication.

Of 22 maxillary fractures encountered, 7 involved the orbit; 5 were represented by oromaxillary fistulas, of which 3 followed dental extraction; 2 were associated with buccal wounds penetrating the antrum; 1 was of an extensive evulsive type with maxillofacial deformity and nasopalatal fistula; 2 others included the zygomatic bone; another involved the infraorbital region and anterior part of the maxilla.

Wherever possible in early cases, the reduction was accomplished through a modified Caldwell-Luc approach or by infraorbital incision or through the external buccal wound sometimes associated with the injury, if conveniently located. On manipulation the realinement of the displaced skeletal structures normally occurred spontaneously. In older cases it was necessary first to remove the granulation tissue existing between apposing fragments of bone. Persistent oromaxillary fistulas of the postdental extraction type were satisfactorily closed by buccal flaps at the time of the Caldwell-Luc procedure. Of the 2 zygomatic fractures, one was manipulated externally into good position; the other required levering through a buccal angle approach. The patient with the extensive evulsive defect was returned to the United States. Our activities in the last-named type of case embraced the following procedures: replacing and retaining of the existing tissues in optimum position; reduction of hazards of infection; provision of temporary prosthesis as necessary; facilitation of a normal intake of food; maintenance of morale.

The 15 fractured mandibles were incentives to exercise of ingenuity on the part of the oral surgeon, who continued along the line of a policy established at our previous station. External pin fixation, with plaster being used to fix the screws, was tried in 1 case and discarded because of difficulties in achieving an adequate plaster-metal locking.

FINALE IN MARSEILLE

Ninety days after D Day in Southern France, the 69th Station Hospital debarked in a dilapidated Marseille, headquarters of the Delta Base Section. Patients began to pour in faster than wards could be constructed, from Dec. 8 to 22, 1944. The hospital was in the direct line of evacuation from forward areas to the United States via Marseille, the largest active port in France at the time. To round off the admission load, a group of extensively injured German prisoners of war, patients from the Strassburg Hospital, were included for an indefinite period of care. Recollections of that time involve a nightmare of paper work required in the admission and disposition of a large number of patients and an unending sequence of dressings. Occasionally, American patients were processed so rapidly that little more than a bandage could be changed and a quick survey made as to suitability for ocean travel under less specialized attention.

In looking at this phase in retrospect one marvels at the way everyone pitched in with maximum effort to clear the overwhelming burdens, working till dead tired, sleeping awhile, working again, and not permitting oneself too much thought as to when it might all ease up.

A detailed summary of EENT admission diagnoses in the period from December 8 to 22 was made. Later records were limited to bare essentials as required for operational statistics by the European Theater of Operations, U. S. A., Headquarters. Among the 25 maxillofacial fractures noted in the sixteen day period there was not a single simple nasal fracture. A high percentage of the wounded were infected.

A representative group of these maxillofacial diagnoses has been selected for presentation in an endeavor to portray the nature of the injuries confronting us after a relatively quiet time in Africa.

Gunshot wound, cheek to mastoid process, with chronic suppurative otitis media.

Gunshot wound, nasomandibular, perforating.

Machine gun wound, jaw, infected.

Shell fragment wound, extensive, destructive, involving the upper part of one side of the face, the eye, the ear and the forehead.

Shell fragment wound, chin, destructive, extensive.

Shell fragment wound, forehead, abdomen, thigh, leg.

Status after reduction of a fracture of the mandible.

Status after reduction of a maxillary-nasal-zygomatic fracture.

Wound, infected, antromaxillary fistula.

The patients with these injuries arrived from five days to many months after the injuries had been incurred, each presenting individual problems of care.

The 69th Station Hospital at this time received orders to move on to the Franco-Italian frontier bordering Nice. Operation of the existing hospital plant was transferred to the 235th General Hospital staff recently arrived from the United States. As there was a lack of any EENT officers, I was assigned to continue with the latter unit, in charge of the EENT section. Major Marcus Randall, of Louisville, Ky., in the Dental Corps, was the oral surgeon of the General Hospital.

Patients continued to pour in. The change of administration coincided with an ever mounting increase of basic activity. After several months, an otolaryngologist, Captain David Frank, of New York, in the Medical Corps, arrived from a field hospital to join the EENT officer staff.

Noteworthy surgical procedures carried out during our sojourn in Marseille consisted of: sequestrectomy for fracture of the mandible; incision and minimal curettage for osteomyelitis of the mandible following fracture; sequestrectomy and curettage of osteomyelitis of the orbital process of the frontal bone; and, by the oral surgeon, numerous rewirings of fractures of the mandible and the maxilla and preparation of improved prostheses and splints to replace the cruder and hastily made devices which had been applied at previous installations.

A summary of the data from the 235th General Hospital reveals that from Jan. 1 to June 1, 1945, 477 men were admitted to the EENT section. An estimated 52 with maxillofacial fractures were processed. In addition, 794 EENT consultations were held with regard to patients in other sections. An outpatient consultation clinic for regional dispensaries and station hospitals provided 1,073 EENT treatments and 1,059 physical examinations for various purposes.

Inpatient work was divided into three general treatment categories consisting of, first, American patients for holding care pending movement to the United States; second, American patients who could be returned to duty within a designated maximum period averaging thirty to sixty days, and, third, German prisoners of war, whose length of stay in many cases might be assumed to be for at least one hundred and twenty days.

American patients arrived in an excellent state of nourishment and morale; every medical or surgical procedure reasonably and safely possible had usually been resorted to as time permitted. Ingenious devices had been applied to provide comfort and promote healing processes as a better groundwork for later reconstruction. Plasma, blood, penicillin and sulfonamides had not been spared. No conservatism was practiced in the use of tracheotomy. We were pleased to note

that fractured mandibles were only rarely immobilized by interosseous wiring. Interdental and intermaxillary wiring with elastic traction was the favorite procedure. Where a portion of the mandible was lacking, plating was occasionally used, but the results seen in passing could not be commended. A variety of novel dressings paraded by in a brilliantly informative procession.

When first seen, the wounded German prisoners of war were a miserable lot. They were frightened and malnourished. Dressings were old, and wounds were usually extensively infected. Many of the compound, comminuted fractures of mandibles were the result of fist or rifle butt blows. Those who were evacuated from the Strassburg Hospital yielded illuminating information as to the German management of mandibular and maxillary fractures. Their methods of fixation favored the application of bands or wires to the teeth for fixing of wire springs or bars, with jaws wired together in proper occlusion. These were regarded as clumsy, bulky and unnecessarily torturous appliances by our oral surgeons. The osteomyelitis present in all of these neglected patients presented a rather hopeless prognosis as to early recovery and conservation of much of the remaining mandible or inferior maxilla.

Under conditions of improved nourishment, use of sulfonamide drugs, courses of penicillin for those with more severe involvements, removal of cumbersome German splints and rewiring by the dental surgeon as described heretofore, astounding progress resulted. Sequestrectomy and curettage were employed only after an initial period of one and a half to three weeks had been allowed for what may be described as localization of the process in the relatively improved environment to which the patients were exposed. After such surgical intervention, penicillin-soaked wicks were inserted in the wounds, being refreshed at least three times daily for one to two weeks.

Meriting mention here is our use of the modified Roger-Anderson type of external pin fixation for edentulous mandibles with multiple fractures. In 1 case, in which we were faced with the possibility of removing most of a shattered mandible involved in an osteomyelitic process, complete healing was accomplished by resort to such pin fixation of the four large bone fragments present, in conjunction with the parenteral and local use of penicillin after minimal sequestrectomy and curettage. The early freedom of jaw movement possible with this locked pin device was spectacular. Patients began to munch on a special soft diet three days after insertion and locking of the pins. Healing proceeded rapidly, the pins being removed after six weeks in these otherwise considered difficult cases.

One word as to anesthesia is appended. Use of barbiturates for general anesthesia was forbidden by theater directive for maxillofacial cases, having been found hazardous to life.

TREATMENT GUIDE

The general principles and procedures to be followed in the treatment of maxillary and mandibular fractures may be formulated as follows:

In early stages:

1. Vigorous antishock therapy.
2. Decision for tracheotomy not to be influenced by excessive conservatism.
3. Liberal use of penicillin and sulfonamide compounds.
4. Avoidance of barbiturates for general anesthesia.

Later:

1. Adequate diet. Dietitians should be made "liquid jaw diet" and "soft jaw diet" conscious.
2. Careful application of suitable intraoral splinting devices, or, if indicated, external pin fixation as modified for use in fractures of jaws.
3. Minimum period of immobilization of jaws.
4. Active and meticulous attention to oral hygiene.
5. Where considerable avulsion of tissues has occurred, early thin skin grafts may be used for provision of a protected surface, pending reconstructive procedures.

In cases of osteomyelitis:

1. Minimum sequestrectomy and curettage, through ample incision, after an initial period of preoperative reestablishment of normal metabolic levels.
2. Local and parenteral administration of penicillin.
3. Fixation of fracture by most simple means.

SUMMARY

One hundred and fifty-seven cases of maxillofacial fracture are reviewed as observed in an army hospital at its three consecutive locations adjacent to Mediterranean ports.

A general treatment guide is presented.

116 East Fifty-Eighth Street.

AURAL SCOTOMAS PRODUCED BY GUNFIRE

A Study of Audiometric Curves of Traumatic Deafness

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CHICAGO
AND
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AMONG soldiers being separated from the service it has been observed that a number have aural scotomas which can be traced to the time or times that they were placed near gunfire, shellfire or blasts. These men were all between 20 and 30 years of age. Many of them had served with the infantry, artillery, engineering corps or tank corps and were exposed to periodic or more or less constant shellfire or gunfire. A large number of the men who were not in the aforenamed branches of the service stated that their trouble started after they had been exposed to rifle fire on the rifle ranges during their basic training and that it had not disappeared in varying durations of time from one to three years.

The chief complaints offered by these men when we saw them were, first, that they were unable to hear a watch tick when held close to the ear and, second, that they had a persistent ringing in their ears, which was worse at night. With few exceptions, these men exhibited normal drums and normal movements of the drum membrane as shown by Siegle's speculum. The tuning fork tests showed normal hearing with the occasional exception of the Schwabach test, in which one could occasionally demonstrate diminished hearing with some of the forks. We observed no vertigo or nystagmus in cases of this series.

Our series consisted of 260 cases, or about 8.9 per cent of all the cases in which a patient passing through the separation center was given special otorhinolaryngologic examination. From our observations in these cases it seems that the smaller the caliber of the gun, the higher the incidence of acoustic scotomas. This will be understood as not including guns smaller than 30 caliber, nor does it include the carbine rifle. Large guns, such as the 155 mm. howitzer and 240 mm. guns, produced relatively few aural casualties, while small guns, such as the Garand rifle, produced a large number of such casualties. This may not mean much, however, as there were many riflemen as compared with relatively few artillerymen in the Army; therefore, there were more exposures to rifle

* At the time this article was prepared Dr. Cope and Dr. Johnson were Captains in the Medical Corps of the Army of the United States.

trauma as compared with exposures to the larger guns. The other factor involved was that men who fired the larger guns may have taken more care to protect their ears than the gunners of the smaller ones did. Possibly, too, the pitch of the larger guns may be lower than that of the smaller guns, which factor may explain why there are fewer casualties with the larger guns. Another factor is that the relative number of exposures to gunfire of the smaller guns is larger than that to the large guns, because of the relatively few times per minute that a large gun can be fired as compared with the smaller gun.

It is also interesting to note that the ear nearer to the traumatizing noise is the ear most commonly affected. This was particularly true in regard to the infantry riflemen. Those men who fired the rifle from their right side had symptoms and hearing losses in their left ears, whereas men firing from the left side had deafness in their right ears. This observation usually held true for the gunners and men about the large guns. Those who were affected usually gave a history of having their affected ear nearer to the gun and the nonsymptomatic ear away from the gun. With shell blasts this localization sometimes held true. In about two thirds of the cases examined there was a localization of the blast on the side of the nonaffected ear.

The protection used varied greatly. Men would tell us that they had used cotton in their ears at times, but that at the time at which their deafness developed they had discarded the cotton or had decided that it was a nuisance and had therefore not used it at all.

Distance from the gun or offending noise, climatic conditions, topography, frequency of repetition of the noise, pitch of the noise, condition of the patient physically at the time of the noise, and type and amount of protection used were all factors in the production of aural scotomas.

The tinnitus observed in most cases had been a persistent condition, worse in quiet areas, but in a few of the cases observed there had been a progressive diminution of tinnitus from the time of the injury until the time of their examination at the separation center. Some of these men told us that the tinnitus decreased slowly in amplitude until it disappeared for short periods only to recur for a short time and then disappear again. They would experience numerous recurrences like this, usually precipitated by another loud sharp noise, such as slamming of a door or the crack of another gun, but that eventually the tinnitus disappeared.

The audiometric curves of these men usually demonstrated the 4096 cycle or high tone drop; hearing curves would be normal or nearly normal until 2048 cycles was reached and then would drop sharply from 2048 to 4096 with a loss of from 40 to 60 decibels. After 4096 some of these curves would rise slightly, but in this series most of them would level off or drop for a greater loss.

It is interesting to note that most of these men did not realize that they had a real hearing loss or had not determined that the defect was a high tone loss. The chief complaint with regard to hearing was that they could not hear their watches tick. Some of these young men were quite frankly worried about not being able to understand the voices of women too well, especially women whose voices were high pitched. One of these young men was a student of operatic singing, who stated that he believed that he had lost all his appreciation of harmonics and overtones, especially those of the higher harmonic chords. A man like this had a much more real disability for civilian life than the average man or the man who was nonmusically inclined.

The agents whose blasts and noises we found to be etiologic factors in the acoustic scotomas are listed here, generally in the order of their etiologic frequency.

1. Projectile hurling devices: Garand rifle (M-1 rifle); 30 caliber Springfield rifle; Browning automatic rifle; 30 caliber light and heavy machine guns; 50 caliber machine guns; 37 mm. and 57 mm. antitank guns; 75, 76, 90, 105 and 155 mm., 8 inch and 240 mm. guns.
2. Explosive shells, dynamite and ammunition dumps: 88 mm. shells, 51 and 80 mm. mortar shells, dynamite and ammunition dumps.
3. Noise-producing motors and heavy machinery: heavy machinery, aviation motors, both combustion type and jet-propulsion type motors.

Of these agents, the one most frequently observed to cause scotomas by its noise was the M-1 or Garand rifle. This was closely followed by the 37 and 57 mm. antitank guns. The machine gun was a frequent offender and appeared to produce a scotoma of its own. With the rapid fire guns the scotoma seems to be much more marked and produces a definite loss for the whispered voice.

There was a case, which will be illustrated later, of low tone loss observed in an Air Corps officer in whom no aural disease could be found. He stated that his hearing was perfectly normal until he was exposed to jet-propulsion engines, which have, according to his story, a rather low-pitched continuous piercing sound. Is it possible that one may have traumatic deafness for low-pitched tones as the result of exposure to a continuous sound?

The audiometric curves following are representative of the various curves seen by us in the examination of these men as they passed through the separation center.

Audiograms I, II and IV (chart 1) are typical of those seen in cases in which the firing of M-1 or Garand rifles was the only etiologic factor.

In audiogram I there is no drop at 128, which is a little unusual. However, there is a normal curve until 2048 is reached, at which point a sharp loss of hearing was found. The point at 11584 was questionable, as at this point the soldier was not sure whether he was hearing his own tinnitus or the audiometric sound.

Audiogram II is that of a soldier who had fired the Garand rifle only during basic training three years prior to examination by us. No other acoustic trauma had been sustained during the remainder of his military service. No tinnitus was found in this case.

In this audiogram one observes a slight drop at 128 in both ears; this is followed by a slight rise to normal until 2048 is reached; then one observes a drop

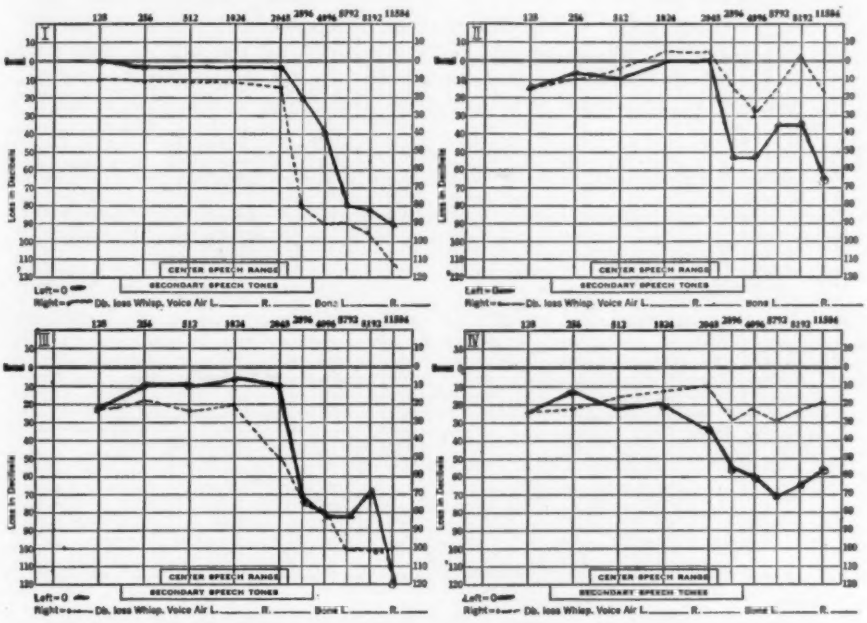

Chart 1.—Audiograms I, II and IV show scotomas due to M-1 rifle fire alone. Audiogram III shows a scotoma due to M-1- rifle and 50 caliber machine gun fire to the noise of which the patient was exposed at different times.

in both ears, most marked in the left ear, the lowest point in the curve being reached at 4096.

Audiogram III was obtained in a case in which more than one weapon had been a factor. This soldier had used an M-1 rifle about three years before his aural examination, and at that time left-sided tinnitus and high tone deafness developed. Later he used the 50 caliber machine gun, and then marked bilateral tinnitus and deafness developed. The 50 caliber gun is fired with the left hand; thus the right ear is the farther away from the gun. In this graph we see a typical Garand rifle deafness of the left ear, but a tonal drop beginning at a lower level and dropping farther in the right ear due, we believe, to the machine gun fire.

Audiogram IV is that of a man who had fired the Garand rifle exclusively and had not been exposed to any other type of traumatic noise. Here the right

ear was not particularly affected while the left ear exhibited damage. No pathologic change except the hearing loss was found in these ears.

With regard to rapid fire guns, there seems to be a particular type of scotoma in which there is a general loss with a drop above 2048 to 4096.

Audiogram V (chart 2) is that of a man who had fired a 30 caliber heavy machine gun over ice and snow one year prior to examination, with development of bilateral tinnitus and hearing loss. Here we find a general hearing loss with a drop to 4096 and then a gradual rise.

In this case there was no pathologic alteration of the ears to be found outside of the auditory loss. The hearing was 8/15 to whispered voice bilaterally, and no abnormalities were observed in the tuning fork tests with the exception of the Schwabach test, which showed general diminution of the hearing over the whole tonal range. This case demonstrates the low hearing acuity of the men who had fired machine guns. The beginning of the curve is lower than normal

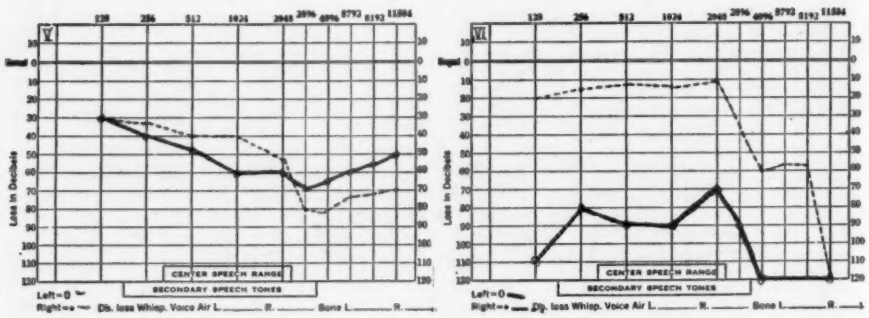

Chart 2.—Audiograms V and VI show scotomas due to firing of 30 caliber machine guns.

and slopes gradually. In the following cases more marked unilateral deafness followed the use of machine guns.

Audiogram VI (chart 2) shows marked deafness of the left ear. This man was in charge of a 30 caliber machine gun and had fired the machine gun in combat about two years prior to examination. His hearing was normal on entry into the Army but decreased sharply after the firing of the machine gun in combat. At present he has marked audible tinnitus in the right ear. In this instance the right ear was closer to the breech of the gun. Here we see a marked left-sided deafness with a right-sided high tone deafness. The 30 caliber machine gun is fired from the right side and usually produces a left-sided involvement of the ears.

We pass now to the 50 caliber machine gun scotomas.

In audiogram VII (chart 3) we observe the same type of marked deafness that was demonstrated by the 30 caliber machine gunners. The difference here is that the deafness occurs in the ear opposite to that involved in the 30 caliber gunners, owing, we believe, to the fact that the 50 caliber gun is fired from the left side and thus the left ear is nearer the breech of the gun. Usually the right ear is affected with 50 caliber gunners. The defect here is a marked general loss in the

right ear with but little if any involvement of the left ear. This man fired the 50 caliber gun only one day in combat and was not more than 18 inches (46 cm.) from the breech of the gun at any one time.

In contrast to this, audiogram VIII shows the hearing of a soldier who was stationed in combat to the left of the 50 caliber gun, with his right ear nearer the gun. Here one observes a general loss in the left ear, with the right or nearer ear unaffected.

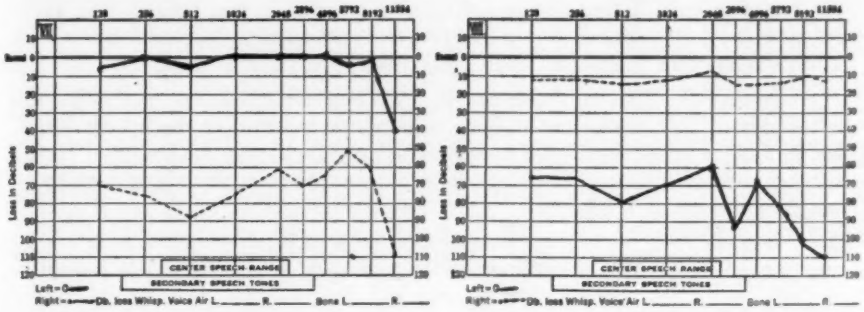

Chart 3.—Audiograms VII and VIII show scotomas due to firing of 50 caliber machine guns.

What then happens to the man who has been exposed in combat to the gamut of these explosive agents? Audiogram IX (chart 4) shows what can happen. This man had been in four campaigns, exposed to all types of fire, both enemy and our own. Here we observe retention of auditory acuity for low tones but a rapid loss of acuity for tones above 512, with a lowest point at 4096.

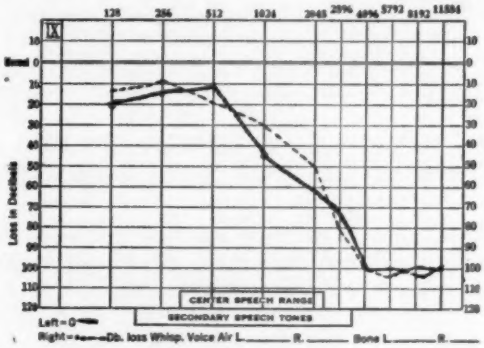

Chart 4.—Audiogram IX shows scotomas due to exposure to all types of fire.

Audiogram X (chart 5) is one fairly typical of men who were exposed to mortar fire. The curve is similar to the M-1 type curve with the exception that the hearing for high tones begins to drop at a lower tone and the drop is bilateral, the losses being almost equal. Among these men we have not seen many who had tinnitus.

Audiogram XI is of a type which has been seen often in the cases of men who worked in the Sherman tanks and fired the 76 mm. gun. It is hard to localize the sound in the tanks because of reverberation, and again one is unable to tell

whether or not the gun or the tank motor had more to do with the tonal loss. There is a general drop above 2048.

The next four audiograms (XII through XV, chart 6) show the variability of shell blast damage. The only similarity is that they all have drops to 4096.

The first of this group (XII) shows the result of being about 50 yards (46 meters) away from an ammunition dump when it exploded. The blast occurred about 50 yards to the patient's right rear, and here one sees the worst damage being done to his left ear. This man had bilateral tinnitus.

Audiogram XIII shows the effects of a 105 mm. shell blast one year prior to examination. This blast occurred 125 yards to the left rear of the soldier. He has tinnitus in his right ear and never has had any tinnitus in his left ear. Here there is an approximately equal loss in both ears, however, and a slight general loss over the whole tonal range.

Audiogram XIV is that of a man who is lucky to be alive. He was in a slit trench when an 88 mm. shell exploded 10 yards (9 meters) ahead of him and

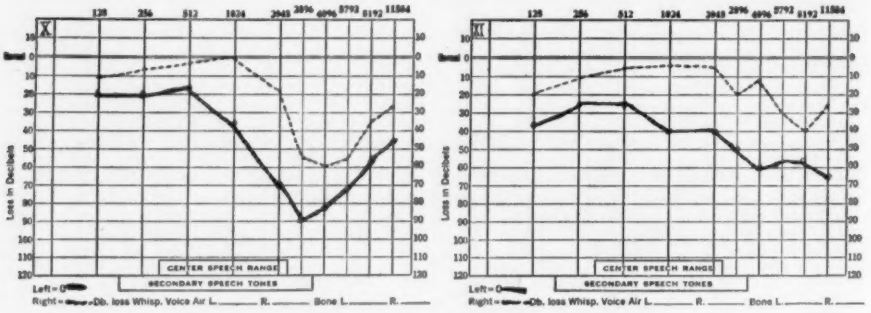

Chart 5.—Audiogram X shows scotomas due to mortar fire. Audiogram XI illustrates scotomas sustained by tankmen.

slightly to the left. The only injury he had following this was a marked loss of hearing bilaterally over the whole tonal range with but slight indication of a high tone loss.

Audiogram XV is that of a man who was resting in a house in Germany for the night when a shell, either an 88 mm. or one of comparable caliber, landed in the street. Here again the only effect was the loss of hearing shown, a general loss with a suggestion of a high tone loss.

We found no indication that previous aural disease offered any protection or conferred any immunity to traumatic deafness, as audiogram XVI (chart 7) shows.

This man had chronic otitis media with a general hearing loss prior to service. After he had been on the rifle range three times, a high tone deafness developed. Bilateral tinnitus developed at the same time. He had had no acute flare-ups of his otitis during service. Here one sees a general loss over the whole range with a high tone loss like that observed with the Garand rifle scotoma.

Audiogram XVII (chart 7) illustrates the only case of its kind that we have seen. It is that of an Air Corps officer who has a low tone deafness following

exposure to jet-propulsion motors. His hearing was normal prior to exposure to these motors but after exposure, he stated, he became progressively less and less acutely aware of low tones. His hearing for the whispered voice was 15/15, but

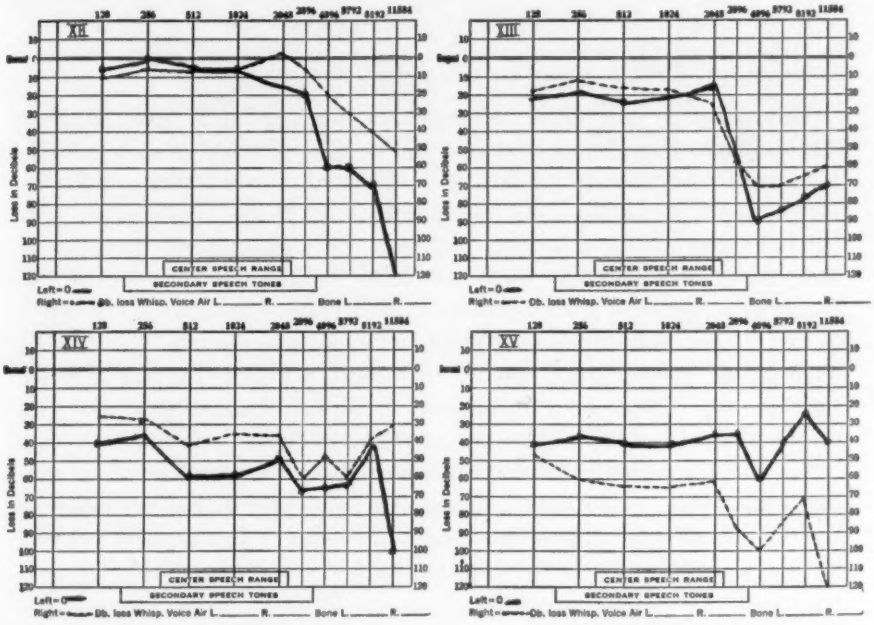

Chart 6.—Audiogram XII shows scotomas caused by explosion of an ammunition dump.

Audiogram XIII shows scotomas due to the blast of a 105 mm. shell exploding 125 yards (114 meters) away; audiogram XIV, scotomas due to the blast of an 88 mm. shell exploding 10 yards (9 meters) away; audiogram XV, scotomas due to the blast of an 88 mm. shell exploding 50 feet (15 meters) away.

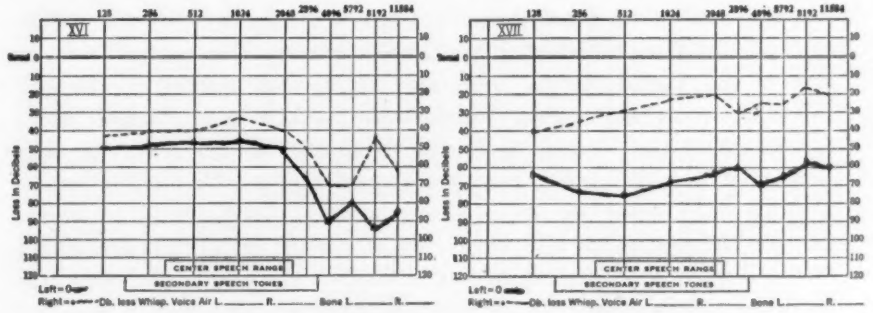

Chart 7.—Audiogram XVI illustrates traumatic deafness sustained over previous chronic otitis media (M-1 rifle deafness).

Audiogram XVII shows low tone deafness due to the roar of jet-propulsion motors.

he could not hear a low-pitched soft voice. The right ear shows a general loss over the whole range; the left ear shows a low tone loss with a gradual rise to 2048, a slight drop, and then a rise.

This man was closely questioned as to any traumatic noises which he had experienced. He had fired no weapons, not even the 45 caliber automatic. There had been no hearing loss when he was working about other motors or flying other type planes. He stated that his trouble started when he had been working around the jet engines, which he said had a penetrating low pitched roar.

COMMENT

In regard to the matter of traumatic deafness it is interesting to speculate why this did not develop in all persons exposed to such trauma. The chances are that it did in a large proportion of the infantry but to such a small degree as to be asymptomatic. On the other hand, why did the noise of the rifle range affect some men and not others who had just as liberal exposures to that noise at the same time and in the same environment? The answer must lie in the individual characteristics of the soldier himself. There must be some immunity to the blasting effect in the soldier who is not affected that is absent in the one affected. Perhaps the contour of the external canal has something to do with the individual protection of the unaffected soldier. Perhaps it may be that in some there is enough cerumen in the exposed canal to stop the initial force of the blast. It may be that the initial sharp shock of the noise is absorbed by the ossicles or the drum. It was demonstrated to us that cotton used in the external canals would appreciably dampen the shock of the blast itself, but from the histories taken it seems that if enough cotton were used to absorb the blast effect, there would be deafness to orders given by the soldier's superior officers and therefore, in the interests of hearing the orders, the protection has to be taken out or not used.

It is also interesting to speculate on how long this deafness will last. In most of the cases in our series the defect was more than a year old and as yet no improvement has been observed by the soldier himself. In cases in which it had lasted three to four years there was little, if any, improvement. The same holds fairly true for the tinnitus observed. In most cases of mild deafness there was tinnitus which had eased up considerably since the traumatic incident. In the cases of marked loss of hearing there was usually intractable tinnitus which had remained about the same since the injury. We tend to believe that the tinnitus which lasts over a six month period without any easing off has little chance of disappearing by itself. We also are led to believe from our observations that the deafness incurred traumatically is a permanent affair, but further studies are needed with follow-up to prove this point.

With regard to the scotomas seen, the most common type is that accompanying the firing of the Garand or M-1 rifle. This is a scotoma which drops from a normal at 2048 to a point from 10 to 60 decibels lower at 4096 and then either rises or continues to fall. This is a

relatively consistent finding. The second most common type of scotoma seen is that associated with the rapid fire guns, in which there is usually a general drop or loss of hearing in the ear nearer to the gun, with a relatively normal hearing range in the unaffected ear. This type of scotoma also shows the drop at 4096. The remainder of the types of blasts that produced scotomas all produced the same type drop to 4096. Now comes the interesting question. Why does the drop usually occur at 4096? Is this pitch common to all noises? This hardly seems plausible, because even in the aviator who had no high-pitched noises near him that tonal drop was exhibited. Is it plausible that the area in the cochlea that receives the 4096 and neighboring tones is the weakest in the cochlea and therefore the most readily damaged? Or may it be that the 4096 area in the cochlea would be the area to receive the most of the initial shock of the traumatic noise and thereby receive trauma to the receptors of that and its neighboring pitches?

SUMMARY AND CONCLUSIONS

About 8.9 per cent of the soldiers being examined for complaints referable to the ear, nose and throat in the separation center were found to have high tone deafness due to the acoustic trauma of gunfire, shell-fire and blasts. The following observations were made:

1. The tonal drop following a blast or gunfire usually occurs from 2048 to 4096 cycles, with the maximum effect being reached at 4096 cycles.

2. Tinnitus usually accompanies this type of traumatic deafness in varying degree and usually is intractable.

3. A particular type of tonal loss was seen in those exposed to rapid fire guns.

4. No aural disease could be found with these hearing losses to account for them.

5. We found no support for the theory that a diseased ear offers immunity to traumatic deafness.

6. The smaller the caliber of the gun, the larger the number of cases of traumatic tonal deafness with exclusion of the carbine 30 caliber and smaller weapons.

7. The ear nearer to the traumatizing noise seems to be the one most commonly affected by the noise and usually exhibits the most loss of auditory acuity.

8. The distance from the traumatizing noise, the climatic conditions, the topography, the repetition of the noise, the patient's condition and the amount of protection used were all factors in the production of the acoustic scotomas.

9. The measures offered by the Army as preventive of acoustic trauma were entirely inadequate, mainly because the soldiers would not use them. The chief complaint was: "I could not hear orders given when ear plugs were in place; therefore I just didn't wear them."

Captain Jack B. Horrocks, of the Medical Corps of the Army of the United States, rendered valuable assistance in this study, and Dr. M. M. Hipskind, formerly lieutenant colonel in the Medical Corps of the Army of the United States, now discharged, gave suggestions and encouragement.

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1. Cope, B. A., and Johnson, H. B.: Observations on EENT Pathology in Separatees Passing Through an Army Separation Center, unpublished data, February 1946.

2. Hipskind, M. M.: War Injuries to the Auditory Apparatus: Clinical and Audiometric Observations, Laryngoscope **55**:678-705 (Dec.) 1945.

Case Reports

OTITIC SEPSIS DUE TO THE COLON BACILLUS

JOSEPH G. DRUSS, M.D., NEW YORK

OTITIC SEPSIS due to Bacillus coli is a rare occurrence. In a series of over 120 cases of thrombophlebitis of the sigmoid sinus of otitic origin with positive blood culture encountered at the Mount Sinai Hospital over a period of twenty years, the colon bacillus was not recovered from the blood stream in a single instance. Yet the colon bacillus was held responsible for 2 per cent of the cases of sinus thrombosis collected from the literature by Haymann [1] for the years 1907 to 1920. Whether this organism was isolated from the blood stream in each instance, however, could not be determined from the data presented in his report.

The colon bacillus is a relatively infrequent inhabitant of the tympanic cavity. When present it is usually encountered in chronic suppuration of the middle ear, in association with the gram-positive organisms—the streptococcus, the pneumococcus or the staphylococcus. In the acute exacerbations it is the latter organisms that usually become activated and go on to invade the adjacent structures or to enter the blood stream. Rarely does the colon bacillus assume these invasive characteristics as in the case to be reported herein.

With the advent of chemotherapy the incidence of sinus thrombosis (as well as that of the other intracranial complications of otitic origin) has been materially reduced. This, in all probability, is due to the fact that the gram-positive cocci, which are particularly sensitive to the sulfonamide drugs and to penicillin, are inactivated or destroyed long before they are given an opportunity to invade the blood stream. The colon bacillus, on the other hand, is decidedly more resistant to these therapeutic agents and continues to proliferate in spite of their use. Consequently it is reasonable to assume that unless a more specific agent is found, a relative increase in the number of cases of otitic sepsis due to this organism can be expected in the future.

From the Otolaryngological Service and the Department of Laboratories, Mount Sinai Hospital.

1. Haymann, L.: Die otogene Sinusthrombose und die otogene allgemein Infektion, in Denker, A., and Kahler, O.: Handbuch der Hals-, Nasen- u. Ohrenheilkunde, Berlin, Julius Springer, 1927, vol. 8, p. 54.

REPORT OF A CASE

S. S., a woman aged 61, was admitted to the Mount Sinai Hospital on June 22, 1943, with a history of having had a virus pneumonia ten months previously, from which she apparently recovered. This was followed two months later by repeated attacks of chills and a rise in temperature to 104 F., from which she also apparently recovered. The patient continued to have a low grade fever, associated with cough, for the next eight weeks. She was admitted to another institution on April 28, was treated for five weeks and was then discharged as having a fever of unknown origin. Two weeks prior to her admission to the Mount Sinai Hospital the fever and chills recurred, and ten days later the patient went into a state of semistupor.

Examination revealed a pale elderly woman, dehydrated and semistuporous, with urinary and fecal incontinence. Her temperature was 104.8 F.; pulse rate, 130; respiratory rate, 24; blood pressure, 108 systolic and 52 diastolic. The pupils were regular and equal, reacting to light and accommodation. The disk margins were blurred, and the right disk was slightly elevated. The liver and the spleen were palpable. The heart and the lungs were normal. The positive neurologic findings were mild palsy of the right external rectus muscle and bilateral depression of deep reflexes and a bilateral Babinski sign.

Otologic investigation revealed a perforation of the right drum posterosuperiorly, with very scant if any discharge from the middle ear, no tenderness over the mastoid process or other evidence of an acute exacerbation. The left ear was normal. A diagnosis of chronic involvement of the right middle ear was made. She was advised to have a roentgen examination of the mastoid processes and petrous pyramids and a culture of the discharge of the middle ear made.

Laboratory data were as follows: red blood cell count, 3,210,000; hemoglobin, 60 per cent; white cells, 9,150, of which 67 per cent were segmented, 17 per cent nonsegmented, 13 per cent lymphocytes and 3 per cent monocytes. The erythrocyte sedimentation rate was 11 mm. per hour. Culture of the discharge from the middle ear revealed Bacillus pyocyaneus. The spinal fluid pressure was 220 mm. of water, with a rise to 360 mm. on compression of the jugular vein and a final pressure of 80 mm. The Wassermann test was negative. The blood urea nitrogen amounted to 16 mg., sugar to 150 mg. and total serum protein to 6.2 Gm. per hundred cubic centimeters; the icteric index was 2. Agglutination tests with typhoid, paratyphoid, dysentery and proteus bacilli and brucellas all gave negative results.

Culture of the blood revealed B. coli in all flasks and in the original liver tube used for this purpose.

Since there was little or no evidence that the sepsis was otitic in origin, a thorough search for other possible causes was made. The abdominal viscera—kidneys, gallbladder and bowel—were carefully investigated, but all proved to be normal.

On sulfadiazine therapy the temperature, which previously had reached 104 F., gradually receded to normal. However, in spite of this therapy the temperature subsequently rose to 101 F. on repeated occasions, indicating either a secondary drug fever or a lack of response to the drug. The administration of sulfadiazine was therefore discontinued at the end of three weeks' use. Because of pain in the right upper jaw and on the right side of the head, the teeth were investigated, but they also were found to be normal. Use of acetylsalicylic acid, blood transfusions and intravenous injections of dextrose likewise failed to produce any signs of improvement. Blood cultures made on five different occasions after the original positive one were all consistently sterile. The ears were examined repeatedly,

but at no time was there evidence of acute suppuration of the middle ear. For two weeks prior to death the temperature curve was of the spiking type, with a peak of 106 F., and two days before death signs of an abscess of the left temporal lobe developed, i. e., mental disorientation, weakness of the right arm and leg, increased deep reflexes, paresis of the right side of the face indicating involvement of the central nervous system, protrusion of the tongue to the right and absence of abdominal reflexes. Roentgen examination of the skull and of the mastoid process done on that day disclosed a destructive process in the right mastoid

Fig. 1.—Section through the antrum showing a perforation (*P*) of the drum with a tract (*T*) leading from the external canal to the antrum (*A*). The antrum is occupied by cholesteatoma. The cholesteatoma has entered the posterior semicircular canal at *P'C'*. *A* indicates the antral cavity with cholesteatoma; *E A C*, the external auditory canal; *F*, the facial nerve, and *P C*, the posterior semicircular canal.

process with decalcification and possible erosion of the sinus plate and of the tegmen tympani et antri. She died in her tenth hospital week.

Postmortem examination disclosed in the right middle ear and mastoid process a large cholesteatomatous mass encroaching on the petrous pyramid and eroding the cortex of the middle and the posterior fossa. A suppurative thrombophlebitic process was present in the sigmoid and transverse sinuses, extending to the great longitudinal sinus. A localized collection of pus, presumably extra-arachnoid, was

seen in the left frontoparietal area. Cultures made of the cholesteatomatous material and of this collection of pus revealed B. coli.

Histologic examination of the right temporal bone showed the mastoid bone to be of the diploic type, comprised chiefly of dense fibrous marrow and showing no evidence of pneumatization. The tympanic cavity was partially replaced by dense connective tissue, particularly noticeable in the region of the oval and round windows and in the attic. Within this connective tissue were multiple cystic cavities. The tympanic membrane was thickened and retracted, the malleus and the incus had undergone extensive resorption of bone, but the footplate of

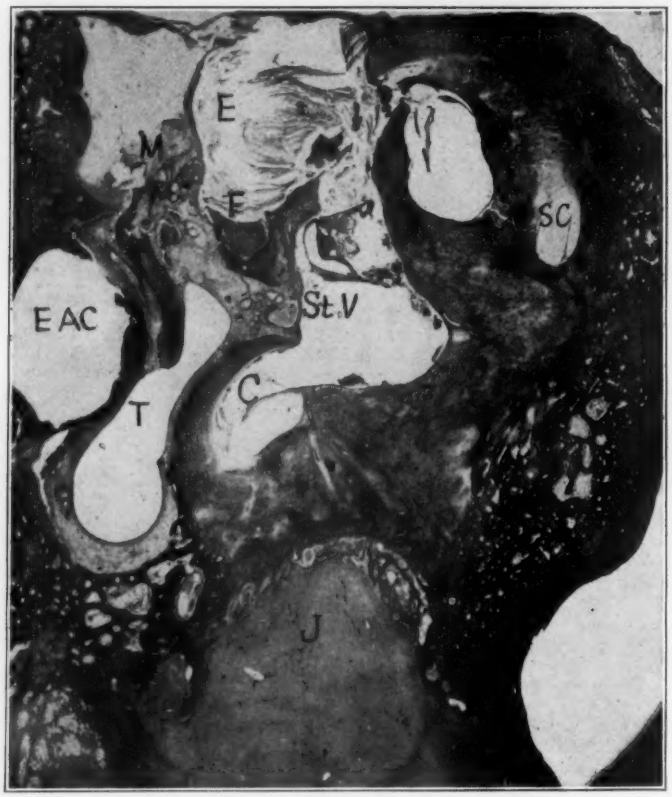

Fig. 2.—Section through the tympanum showing cholesteatoma in the epitympanic space. The cholesteatoma has eroded the labyrinthine capsule and has entered the vestibule. It has also eroded the head of the malleus and the incus and has exposed the facial nerve. An organized thrombus in the jugular bulb with new bone formation on the margins can be seen. *C* indicates the cochlea; *E*, the epitympanic space with cholesteatoma; *E A C*, the external auditory canal; *F*, the facial nerve; *J*, the jugular bulb, thrombosed; *M*, the malleus; *S C*, the superior semicircular canal; *St*, the stapes; *T*, the tympanum, and *V*, the vestibule.

the stapes was uninvolved. In the superior posterior part of the drum membrane a marginal perforation could be seen, which formed the outer exit of a narrow tract leading mesially and posteriorly into the antrum. This tract was lined by squamous epithelium as a result of invagination of the epidermal layer of the

drum membrane and external canal, and this lining assumed the characteristics of a typical cholesteatomatous matrix (fig. 1). The cholesteatoma extended backward to the antral cavity and medialward along the roof of the tympanum and petrosa to about the level of the internal auditory meatus. In its growth it had eroded the inner table of the posterior and middle fossa of the mastoid process and of the petrosa, exposing the dura over these areas. It also caused necrosis of the bony labyrinthine capsule at various sites with production of relatively large fistulas of the external and the posterior semicircular canal and of the dome of the vestibule. The cholesteatoma eroded the fallopian canal and exposed the facial nerve almost throughout its course in the middle ear (fig. 2). The membranous labyrinth within the vestibule and semicircular canals was almost entirely disrupted or destroyed. The facial nerve in spite of its prolonged exposure to the direct pressure of the cholesteatoma during the illness showed little if any histologic alterations within the nerve fibers themselves. Multiple small pathologic fractures occurring within the petrosal bone and partially lined by cholesteatomatous debris were an unusual feature. Frank purulent exudate was present in the internal auditory meatus and in the aqueductus cochleae. A well organized thrombus of relatively long standing, as evidenced by the extensive new bone formation in the jugular dome, was found to obliterate the lateral sinus from the torcular end to the jugular bulb (fig. 2). Sections of the sinus wall, however, failed to show any pathologic features characteristic of the colon bacillus.

COMMENT

A review of this case with all the data on hand discloses the fact that the patient had had a chronically discharging right ear with cholesteatoma for many years. Without any clinical evidence of exacerbation, the cholesteatoma had extended to the lateral sinus, giving rise to the classic symptoms of sepsis—spiking temperature and chills. These symptoms had continued, except for periods of remission, for more than ten months without a diagnosis ever being established. The infectious process in the lateral sinus had advanced by retrograde extension beyond the torcular and produced an abscess of the parietal lobe on the opposite side with meningitis, from which the patient finally succumbed.

The cholesteatoma had also invaded the labyrinth and the petrous pyramid, the former through multiple fistulas of the bony capsule and the latter by way of a tract leading from the epitympanum to the supralabyrinthine spaces. There was likewise no clinical evidence of labyrinthine involvement during the illness. Tuning fork and vestibular tests, however, could not be performed, because the patient did not cooperate satisfactorily. The paresis of the right external rectus muscle observed on admission and the severe pain of the side of the face observed later are probably best explained by the suppurative process within the petrosa noted histologically.

While the sulfadiazine therapy was not effective in controlling the spread of the infectious process in the ear, it apparently did succeed in improving for a time the clinical condition of the patient and probably

was a factor in freeing the blood stream of colon bacilli in the late stages of the illness—a good illustration of the effect of the sulfonamide compounds in "masking" the clinical picture. That the sulfadiazine therapy alone did not produce a cure in this case is not at all surprising, since it is well recognized that the colon bacillus (in general) is resistant to this drug and that the drug itself exerts little or no favorable influence on a chronically discharging ear, particularly in the presence of cholesteatoma. Whether the outcome in this case would have been different had the diagnosis been made early and surgical intervention initiated at the time is purely problematic. Nevertheless, there can be no question but that the early removal of a focus of infection combined with adequate chemotherapy is still the method of choice in handling such cases.

ADDENDUM

Within the past year, since this paper was submitted for publication, both sulfamerazine and streptomycin have proved efficacious in the treatment of infections due to some strains of the colon bacillus. While full advantage should be taken of these relatively new drugs, it must be borne in mind that they do not entirely supplant the other sound therapeutic procedures.

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Clinical Notes; New Instruments and Technics

COCAINIZING THE TYMPANUM VIA THE EUSTACHIAN TUBE

A New Method

MAX UNGER, M.D., NEW YORK

THE METHOD of cocainizing the middle ear that I am about to describe can be used by the otolaryngologist in his office just as he uses the topical application of cocaine to anesthetize the mucous membrane of the nose there.

A brief review of the histology of the mucous membrane of the eustachian tube and middle ear will show the basis of my method. The eustachian tube is lined with ciliated columnar epithelium which is similar to, and continuous with, the epithelium of the nasopharynx. The mucosa of the eustachian tube merges with the mucosa of the middle ear. The epithelium of the latter on the floor and the walls near the orifice of the tube is of the ciliated low columnar type. Further in, the epithelium becomes squamous in character. The continuity of the mucous membrane of the middle ear and eustachian tube with, and its resemblance histologically and physiologically to, the mucosa of the nose and paranasal

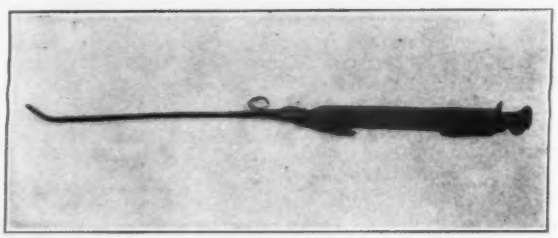

Fig. 1.—Apparatus used in cocainizing the middle ear for painless paracentesis.

sinuses suggest that it is equally susceptible to the influence of cocaine locally applied. I have proved this to be true by test. The problem then was to devise a method of applying the cocaine to the eustachian tube and middle ear. This was done by utilizing the simple law of gravity, as will be described.

The apparatus which I use is shown in figure 1. It consists of an ordinary eustachian catheter, a glass tuberculin syringe, an adapter to fit the catheter onto the hub of the syringe and a locking device to keep the syringe and the catheter from being separated during the manipulations incident to passing the catheter. The method is as follows. The patient lies flat on his back on a table, with his head and shoulders on the same level. When he is in this position the mouth of the eustachian tube is directly below the inferior meatus of the nose and will hold any fluid that is instilled in it. In addition, since the direction of the tube is now mostly downward, if the tube is opened, the fluid will have a chance to flow down into the middle ear. The syringe is filled with a 10 per cent cocaine solution and attached to the eustachian catheter, and all the air is forced out of both. A careful reading is then made of the fluid in the syringe. The catheter, with the syringe attached, is now passed into the eustachian tube of the affected

side by the usual technic of catheterization of the eustachian tube. It will be found to be rather easier to do this with the patient in the supine position, because in this position the pharynx falls away from the mouth of the tube so that the latter stands out more prominently and is found more easily than when the patient is in the sitting position. When the beak of the catheter is in the mouth of the tube, the catheter and syringe will be in the vertical position and will stay in place without being held. Figure 2 is a photograph of a patient with the apparatus in place, and figure 3 is a diagram showing the relation of the catheter to the parts.

Fig. 2.—Patient with the apparatus in place.

When the catheter is in proper position, 0.025 cc. of the cocaine solution is instilled into the torus tubarius. After four or five minutes, the catheter is partially withdrawn so that the beak is in the nose, the patient's nostrils are pinched, and he is told to swallow. The act of swallowing opens the eustachian tube, and the solution in the torus has a chance to drop into the middle ear or at least as far as the engorged condition of the tube will permit. The catheter is withdrawn into the nose because the contraction of the pharynx about the beak

may cause pain and laceration of the tube. Forcible inflation of the tube by air pressure from a bag or a pump is contraindicated, because a sudden strong air blast will blow the solution out of the tube into the pharynx. This procedure is done two more times. A total of fifteen minutes is used up from the first instillation.

Haste and impatience do no good and, in fact, defeat their ends. It is useless to instil more than the amount of cocaine specified because the torus tubarius can hold only about a drop of fluid normally. An excessive amount pumped into it will simply run off into the pharynx. Besides, it must be remembered that one is using a potent drug, an excessive use of which may cause unfortunate results.

Within a minute or two after the instillation the patient states that the earache is diminishing. After the second instillation he may say that the pain is all gone. This may be due, however, to the contrast between the excruciating pain he had and the relief produced by the cocaine. There may still be some painful reaction

Fig. 3.—Diagram showing the relation of the apparatus to the parts.

to the paracentesis, as happened in case 1. It is wisest to use the full fifteen minutes and to make three instillations of cocaine solution.

When the fifteen minutes have passed, the tympanic membrane is anesthetized, and the incision can be made slowly, carefully and adequately.

This method, of course, can be used only in adults and in teen age youngsters of the mature type. The problem of anesthetizing the child is still a matter of concern, but it must not be permitted to cause delay of paracentesis if this is necessary.

REPORT OF CASES

Case 1.—A woman aged 27 had suffered from earache of the right side for forty-eight hours. Examination showed a scarlet tympanic membrane, moderate bulging and a bleb in the upper posterior quadrant. Local anesthesia was induced in the manner described and after the second instillation, about eight minutes having elapsed since the first instillation, the patient claimed that all pain was gone. Touching the membrane with a probe produced no reaction; so a vertical

incision was made in the lower anterior quadrant. The patient winced slightly but did not jerk away, and it was possible to make a large, well placed opening.

CASE 2.—A man aged 74 stated that pain developed in the right ear two days before examination. One day later the right side of the face became paralyzed. Examination showed complete paralysis of the right side of the face. Taste was present in the anterior two thirds of the tongue on that side, which showed that the facial nerve was involved distal to the genu. Examination of the right drum showed the membrane to be dark purple, with little bulging. The cocainization method described was used in its entirety, three doses being instilled into the eustachian tube and fifteen minutes being used in the course of the instillations. There was absolutely no reaction to the paracentesis, and it was even possible to enlarge the incision after the initial bleeding had stopped.

CASE 3.—A young man aged 17, a senior high school student, had experienced pain in the left ear for thirty-six hours. The membrane of the left drum was bright scarlet, with moderate bulging. Anesthesia was performed via the eustachian tube as described. Three instillations of cocaine solution were made during the passage of fifteen minutes. A leisurely, adequate and properly placed paracentesis was performed without any reaction from the patient.

I believe that otologists have in this procedure a good method of producing local anesthesia of the middle ear. It is based on the similarity of the mucous membrane of the eustachian tube and the middle ear to the mucous membrane of the nose and paranasal sinuses, on its susceptibility to cocaine applied locally and on the simple law of gravity.

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Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

CHRONIC PROGRESSIVE DEAFNESS, INCLUDING OTOSCLEROSIS AND DISEASES OF THE INNER EAR

Review of the Literature for 1944 and 1945

GEORGE E. SHAMBAUGH Jr., M.D.
AND
ARTHUR L. JUERS, M.D.
CHICAGO

A MAJOR portion of the 1944 and 1945 literature on deafness is concerned with the surgical treatment of otosclerosis and with the otologic problems and observations incidental to modern warfare. As in previous years this review includes only those articles which give some new information relative to the problem of deafness. There were few significant contributions from abroad. The material is arranged as follows:

Otosclerosis
  Pathology and Etiology
  Treatment
Deafness Due to Lymphoid Hyperplasia of the Nasopharynx
Deafness Due to Trauma
Deafness Due to Blast Injury
Deafness Associated with Systemic Disease
Ménière's Syndrome
Miscellaneous Contributions on Causes and Treatment

PATHOLOGY OF OTOSCLEROSIS

Otosclerosis was studied by Guild [1] in his laboratory's collection of serially sectioned human temporal bones. The material was derived almost equally from white persons and Negroes. For white persons the incidence of otosclerosis as demonstrated histologically was 1 in 12, and for Negroes, 1 in 96. This coincides with clinical experience. For white persons the sex incidence was 1 in 8 for females and 1 in 15 for males. For the various age groups, the highest incidence was between 30 and 49 years of age. Only 1 child less than 5 years old had

1. Guild, S. R.: Histologic Otosclerosis, Ann. Otol., Rhin. & Laryng. **53**: 246-266 (June) 1944.

"histologic otosclerosis." In 46 cases both ears were available for section; in 32 otosclerosis was bilateral and in 14 unilateral. In 65 of the 81 ears the otosclerosis was present anterior to the oval window, and 25 had an otosclerotic area at some part of the attachment of the round window. He found that while the material was in agreement with the generally accepted idea that otosclerosis occurs most often anterior to the oval window, it did not support the idea that otosclerosis begins in the fissula ante fenestram. Larger areas of otosclerosis included the region of the fissula, but sections of 4 ears showed the fissula clearly separate and distinct from the otosclerotic area near the oval window. Also 48 otosclerotic areas not anterior to the oval window and 10 in the stapedial footplate obviously could not originate in the fissula. Active and quiescent areas were present in nearly equal numbers. The stapediovestibular articulation had become ankylosed in only 10 of the 81 ears that from a histologic standpoint had otosclerosis. Usually less than half of the circumference of the oval window was connected to the stapedial footplate by osseous tissue. The marginal cartilage was completely replaced with otosclerotic tissue at some part of the circumference of the oval window in at least 27 of the ears in which ankylosis had not occurred. The histologic observations when correlated with the results of hearing tests indicated that otosclerosis did not produce impairment of the hearing unless there was an osseous connection between the margin of the oval window and the footplate of the stapes. Atrophy of cochlear nerve fibers or of the organ of Corti did not occur more often in ears with otosclerotic areas than in ears free from such areas. He concluded from his histologic observations that it would be futile to try to eliminate otosclerosis by eugenic measures, which obviously could be based only on clinical and not on histologic evidence of otosclerosis, which can be diagnosed only on section of the temporal bone. (Comment: This is one of the most significant and valuable studies of otosclerosis that have been published.)

Further investigation was made by Altmann [2] of the possibility of producing otosclerosis in birds. Wittmaack had previously claimed to have produced otosclerotic changes in the labyrinthine capsules of chickens by venostasis. However, he did not report as to whether or not there were any similar changes in other skeletal bones of his specimens. Altmann has now shown that histologic changes of skeletal bones as well as of the labyrinthine capsule similar to those reported by Wittmaack occur in chickens merely kept in captivity. These changes were not present in birds in their natural environment. The changes observed in the birds in captivity may be due to faulty nutrition. The author points out that further experiments on chickens with the afore-

2. Altmann, F.: New Contributions on the So-Called Otosclerosis of Chickens, Arch. Otolaryng. **39**:59-81 (Jan.) 1944.

mentioned facts in mind may be of value in helping to discover some of the factors initiating otosclerosis but would not contribute anything as to the constitutional or the hereditary factors. (Comment: Altmann's observations appear to invalidate Wittmaack's theory of the pathogenesis of otosclerosis and also to invalidate Wittmaack's operation to arrest otosclerosis by altering the venous drainage of the labyrinthine capsule.)

In view of the possible value of drinking water containing nontoxic quantities of fluorine in preventing dental caries and in having some influence on living bone and fibrous tissue, Lewy [3] suggests further statistical and experimental investigation as to the possible value of fluorine in preventing otosclerosis and fibrosis. In four counties near Chicago in which the drinking water contained 1.4 parts per million, 20,488 children were examined and a 2.8 per cent incidence of defective hearing was found. In Chicago, where drinking water is fluorine free, examination of 21,200 children revealed 4.3 per cent with defective hearing. Lewy feels that further studies on this subject should be made. (Comment: Inasmuch as otosclerosis seldom causes impairment of hearing during childhood, the author's statistics would seem to bear no relation to the problem of otosclerosis.)

Barton [4] studied 133 otosclerotic women as to the effect of pregnancy on hearing. Of 114 subjects concerning whom sufficient information was available, 64 per cent were further deafened by pregnancy, 35 per cent were unaffected and 1 had better hearing during pregnancy. As to time of onset of hearing loss in relation to pregnancy, in 59 cases he found that the onset was during the pregnancy in 20 per cent, immediately after pregnancy (during lactation) in 51 per cent, and six months or more after parturition in 29 per cent. Seventy-three cases were studied as to the relation of onset of hearing loss to the number of pregnancies, and in 70 per cent the onset was during the first pregnancy, in 16 per cent during the second, and in the rest in the period from the third to the seventh pregnancy. He also observed that the patient has a 50 per cent chance of experiencing a pregnancy subsequent to the onset of deafness without further progression of deafness which may be attributed to the pregnancy. He also cites a case in which the second pregnancy was terminated by abortion, which was recommended by an otologist to prevent further loss of hearing. A few years later this patient went through a full term pregnancy in spite of the previous advice, and no loss of hearing attributable to pregnancy was experienced. The author feels that abortion is never justified

3. Lewy, A.: Possible Value of Non-Toxic Concentrations of Fluorine in the Prevention of Deafness from Otosclerosis and Fibrosis, Arch. Otolaryng. **39**: 152-154 (Feb.) 1944.

4. Barton, R.: The Influence of Pregnancy on Otosclerosis, New England J. Med. **233**:433-436 (Oct. 11) 1945.

because of otosclerosis in view of the variable and unpredictable relationship between pregnancy and clinical otosclerosis. The effect of previous pregnancies on otosclerosis is not an accurate index of the probable effect of subsequent ones. Also the modern hearing aid and the surgical treatment of otosclerotic deafness have provided a more favorable outlook for these women. He agrees with Guild that sterilization and abortion on eugenic grounds are futile.

Allen [5] concludes as a result of his observation of the effect of pregnancy on otosclerotic deafness that otosclerosis should probably not contraindicate marriage or a trial pregnancy and that otosclerosis should not be considered as an indication for therapeutic abortion in the primipara. However, he believes that a multiparous woman may have considerable right to question the continuation of her pregnancy if accurate otologic evidence obtained in previous pregnancies has shown a marked, sustained loss of hearing. It must also be remembered that even without pregnancy otosclerosis is a progressive disease. Burnham, discussing this paper, thinks that since histologic evidence of otosclerosis is relatively common and clinical evidence of otosclerosis uncommon, hereditary considerations do not justify clinical abortion and that the possible increase of maternal deafness does not justify the procedure. (Comment: No longer can clinical otosclerosis be regarded with the same pessimistic prognosis as formerly in view of the possibility of surgical relief of the impairment of hearing. Nevertheless, clinically otosclerosis undoubtedly shows a strong familial tendency, and therapeutic abortion might be indicated in exceptional cases, such as that in which both parents have the condition.)

Lempert and Wolff [6] examined histologically the incus and the portion of the malleus removed at operation in 115 cases. Typical otosclerotic foci such as those observed in the region of the oval window in clinical cases of otosclerosis were not found in the ossicles examined. Pathologic changes were found in all but 5 cases. The changes were (1) distortion of the shapes of ossicles, (2) blue mantles, (3) changes of marrow spaces, chiefly vascular, and (4) changes of the joints. No correlation was found in regard to blood values for calcium and phosphorus. Decalcification from disuse seemed to be a definite factor in some of the aforementioned changes.

Lowy [7] studied the effect of fenestration of the superior semicircular canal in pigeons in which conductive deafness had been induced by

5. Allen, E. W.: Pregnancy and Otosclerosis, Am. J. Obst. & Gynec. **49**: 32-48 (Jan.) 1945.

6. Lempert, J., and Wolff, D.: Histopathology of the Incus and the Head of the Malleus in Cases of Stapedial Ankylosis, Arch. Otolaryng. **42**:339-367 (Dec.) 1945.

7. Lowy, K.: Functional Studies on Labyrinthine Fenestration in Animals, Laryngoscope **55**:6-19 (Jan.) 1945.

filling the outer meatus with bone wax. Comparing cochlear potentials observed before and after fenestration, he found that fenestration leads to an increase of cochlear microphonics, the gain being greater for the higher intensities. Cauterization of the contents of the fistula reduced the gain only slightly. Removal of a part of the membranous labyrinth led to a considerable reduction in cochlear response. Removal of perilymph without fenestration did not improve the response in artificial conduction deafness. He also observed that injury of small venous canals produced an irreversible drop in cochlear potential. (Comment: This interesting study by Lowy points the way toward further experimental work to explain the mechanics of the improvement of hearing that follows fenestration. Whether the improvement is due to increasing the mobility of the perilymph to sound entering through the round window, or whether the improvement is due to sound entering through the semicircular canal needs to be demonstrated. The improvement of hearing following the operation is apparently largely due to sound vibrations reaching the fenestra from the tympanic membrane, for a perforation of this membrane immediately decreases the hearing, and healing of the perforation or closing it with a paper patch immediately improves the hearing, particularly for the tones of low pitch.)

Shambaugh [8] compared the improvement of hearing following the fenestration operation with that obtained by wearing a hearing aid. In response to a questionnaire sent to patients who had undergone the operation, 83 of 95 who received lasting improvement replied that they heard better without a hearing aid after than they did with an aid before the operation; 10 stated that they heard as well as they did with an aid before operation. In order to study the problem more objectively he had Dr. Scott Reger devise a phonograph-audiometer to measure the threshold for speech with a hearing aid before operation and that for speech without an aid after operation, for comparison. The hearing of 14 patients was measured in this manner. The 7 patients who had average or better than average improvement (a more than 20 decibel gain for the speech frequencies) all heard better without an aid after operation than they did with an aid before. Of 5 patients with less than average improvement (a less than 20 decibel gain for the speech frequencies), none had hearing equal to their preoperative hearing with an aid. Two patients had no improvement. Some of these patients were examined less than six months after their operation, and they may improve further. The author concluded from his statistics that the prospective ideal subject for fenestration would have a 90 per cent chance of a lasting improvement of hearing and approxi-

8. Shambaugh, G. E., Jr.: Comparison of Improvement in Hearing Following the Fenestration Operation with that Obtained by Wearing a Hearing Aid, Arch. Otolaryng. **41**:189-192 (March) 1945.

mately a 70 per cent chance that the hearing after operation would be equal to or would surpass that obtained with a hearing aid before operation.

Lempert [9] discussed all phases of the surgical treatment of clinical otosclerosis on the basis of experience gained in 1,000 case. He stated that present methods of testing bone conduction hearing do not always give an accurate index of the amount of function present in the cochlear nerve. In occasional cases the postoperative hearing by air conduction is well above the preoperative hearing by bone. In deciding which ear to operate on when both ears are deafened to the degree that practical hearing no longer exists in either ear, the ear suspected to possess the greater reservoir of cochlear nerve function should be selected, even if that ear is the better functioning of the two from the standpoint of air conduction. If bone conduction in the two ears is equal, then the ear with the poorer air conduction is chosen. Tinnitus must also be considered.

The two chief occasions of failure have been bony closure of the fenestra and irreversible postoperative inflammatory changes in the membranous labyrinth. With the hope of overcoming these two obstacles Lempert devised a mobile cartilaginous stopple to be inserted into the fenestra. He has used this technic in 50 cases during the last two and a half years, and in none of these has he observed any serous labyrinthitis with damage to the organ of Corti or any bony closure. In the future he expects to use this technic exclusively.

In reporting results he suggests that those persons who have maintained a level of 30 decibels or better for conversational frequencies for twelve months after the operation should be considered to have complete rehabilitation, those showing improvement but not to the 30 decibel level as having partial rehabilitation, and others either not improved or made worse. He reports that of 815 patients with good bone conduction on preoperative examination, 571 obtained complete and 92 partial rehabilitation. One hundred and eighty-five patients had poor preoperative bone conduction and, of these, 42 had complete and 39 partial rehabilitation. The rest were unimproved or worse after operation. One hundred and eighty-seven of 309 patients with good preoperative bone conduction who were operated on from three to seven years ago have maintained practical serviceable hearing, 37 were improved to some extent but not to the practical level, 65 were unimproved, and 20 were made worse. Twenty-four of 75 patients operated on over six years ago have retained practical serviceable hearing. Complete or partial bony closure occurred in 140 of 1,000 patients.

9. Lempert, J.: Lempert Fenestra Nov-Ovalis with Mobile Stopple, Arch. Otolaryng. **41**:1-41 (Jan.) 1945.

Eighty-eight of these were among the first 300 in whom the fenestra was placed in the prominence of the lateral semicircular canal, and 52 were among the last 700, in whom the fenestra nov-ovalis technic was used.

The complications encountered were as follows: Two patients died two weeks after operation of acute coronary thrombosis. One patient had an abscess of the temporosphenoid lobe three weeks after operation and died shortly after surgical drainage. Another patient in whom an abscess of the temporosphenoid lobe developed recovered after surgical drainage and has maintained serviceable hearing. In still another patient thrombophlebitis of the lateral sinus, suppurative labyrinthitis and meningitis developed. Recovery followed appropriate surgical treatment, but with complete loss of hearing in the treated ear. Transient facial paralysis occurred in 14 patients, and all but 1 recovered in two to three weeks. Lempert has observed that secondary changes of the cochlear nerve do not occur in a successfully fenestrated ear to the extent to which they occur in the ear not operated on in the same patient. (Comment: The author's beautifully illustrated and convincingly written article encouraged the hope that the stopple technic represented a distinct advance over previous technics. Further experience does not appear to have supported this hope. Lempert originally measured his results by the average number of decibels gained for the speech frequencies. Now he recommends that the final hearing level alone be considered the measure of success. This method of judging results has two disadvantages. One is that different audiometrists using different technics of testing hearing and different audiometers will find their results varying by as much as 10 decibels. The second disadvantage is that patients with a preoperative hearing threshold showing 32 or 35 decibels' loss may statistically reach the 30 decibel level with a hearing gain of 5 decibels or less—a gain that is well within the range of error and variability. By judging the hearing results of the fenestration operation both by the average number of decibels gained and by the hearing level finally reached, each of the aforementioned disadvantages is overcome.)

MacDonald [10] reports having used a cartilage button to maintain patency of an opening in the temporal bone of a cat.

Kinney [11] suggests that otologists should give the threshold of hearing in terms of the hearing that the patient has, rather than the percentage loss. He also points out, in correlating the American Medical Association method of determining percentage hearing with the usual audiometric

10. MacDonald, P. G.: First Experimental Use of Cartilage to Maintain a Patent Fenestra in Bone, Arch. Otolaryng. **41**:241-242 (March) 1945.

11. Kinney, C. E.: Critical Review of Fenestration Operation, Laryngoscope **55**:117-127 (March) 1945.

record, that a gain of 10 decibels from the 55 to the 45 decibel level represents only a 6 per cent gain in hearing whereas a similar gain from the 45 decibel level to the 35 decibel level is a 24 per cent improvement. He gives a 35 decibel average loss for the speech frequencies as the practical level of hearing. In reporting the results of 8 fenestrations he points out that in 2 of 4 cases in which the result was poor the preoperative bone conduction was lower for the high tones than for the low, and this in the presence of a mobile stapes in these cases suggests that in cases of this type the patient should not be subjected to the fenestration treatment.

Day [12] stated that in order to make fenestration a good gamble for the patient the bone conduction should not drop below 20 or 25 decibels at any point in the speech range. He reported that, of 54 patients, 74 per cent obtained a good result, with practical hearing. Three closures were successfully revised, giving a total of 80 per cent good results. An average improvement of 28.5 decibels was obtained. He stated that a result maintained for six to eight months can be considered permanent, as he has observed no closures after this period of time. (Comment: From an experience of 1,200 consecutive fenestrations, some of which were followed for as long as eight years, the reviewers cannot agree with the author's statement implying that closures do not occur after eight postoperative months. They have observed that loss of the hearing improvement usually occurs within the first year after operation but that occasionally it occurs during the second year. The one year hearing results may be regarded as "probably permanent," and the two year results, as "almost certainly permanent.")

DEAFNESS DUE TO LYMPHOID HYPERPLASIA OF THE NASOPHARYNX

Fowler [13] noted that a high percentage of American flying personnel in England came to hospitals with a history of recurrent acute catarrhal otitis media. The majority had sufficient excess lymphoid tissue around their eustachian tubes to account for the susceptibility to otitis. The flying personnel had a much higher incidence of otitis than the ground personnel. Nasopharyngeal lymphoid tissue was treated with radon. Two to four treatments of 100 milligram hours with filtration of 0.65 mm. of platinum were found necessary to obtain and maintain improvement. Seventy-nine per cent of those treated and followed had no aero-otitis for two months or more. Before irradiation of their nasopharyngeal lymphoid tissue these men had been subject to aero-otitis

12. Day, K. M.: Evaluation of the Fenestration Operation for Otosclerosis, Pennsylvania M. J. **48**:684-686 (April) 1945.

13. Fowler, E. P., Jr.: Use of Radon to Prevent Otitis Media Due to Hyperplasia of Lymphoid Tissue and Barotrauma, Arch. Otolaryng. **40**:402-405 (Nov.) 1944.

after almost every flight. (Comment: This treatment is a direct outcome of the pioneer work of Crowe, Guild and Burnham on irradiation of the hypertrophied lymphoid tissue in and around the orifice of the eustachian tube. This treatment has gained general acceptance for the prevention of aero-otitis.)

Fricke and Brown [14] reported the results obtained in treating hypertrophied lymphoid tissues of the nasopharynx with radium. The majority of patients complained of deafness and tinnitus; others had chiefly colds and sore throats. Definite and permanent improvement was obtained in 59 per cent of those followed, temporary improvement in 17 per cent and no improvement in 24 per cent. Better results were obtained in those treated more than once and in those who were treated with higher doses. The dosage per treatment varied from 1.5 gram minutes up to 3 gram minutes in each nostril. No ill effects were noted.

Rentschler and Settle [15] report their results in treating lymphoid tissue of the nasopharynx in 35 patients with roentgen radiation. Four hundred tissue roentgens were given on each side. In 19 patients there were impairment of hearing and disease of the middle ear. Three were adults with long-standing disease, and they obtained no results. Of the other 16 patients, 8 had hearing restored to normal and 7 did not. Two of the latter had chronic perforations.

Hawley [16] states that when he treated lymphoid tissue of the nasopharynx with 600 tissue roentgens to each lateral wall of the nasopharynx results were not satisfactory. Since increasing the dose to 700 and 800 tissue roentgens he has observed recurrence of lymphoid tissue in only 2 of 26 patients. Those patients with conduction deafness due to tubal obstruction of not too long standing obtained considerable improvement in hearing.

Ashbury [17] found the most satisfactory dosage for lymphoid tissue of the nasopharynx to be 800 to 1,200 tissue roentgens through selected portals over a period of twenty-nine days. In addition the nasopharynx was given a 75 milligram hour application of radium through a 1.0 mm. platinum filter on the fifteenth day of the treatment.

Behnke [18] points out that the mechanism of the aero-otitis of aviators is similar to that observed in the compression and decompression

14. Fricke, R., and Brown, H.: Radium Treatment of Nasopharyngeal Lymphoid Hypertrophy, South. M. J. **37**:399-402 (July) 1944.

15. Rentschler, H., and Settle, J.: Treatment of Impaired Hearing by Radiation of Excessive Lymphoid Tissue in the Nasopharynx, Pennsylvania M. J. **47**:985-988 (July) 1944.

16. Hawley, S.: Roentgen Treatment of Lymphoid Tissue in Nasopharynx, Radiology **43**:254-255 (Sept.) 1944.

17. Ashbury, H.: Radiation Therapy of Lymphoid Tissue in the Nasopharynx, Radiology **43**:250-253 (Sept.) 1944.

18. Behnke, A. R.: Physiologic Effect of Pressure Changes with Reference to Otolaryngology, Arch. Otolaryng. **42**:110-116 (Aug.) 1945.

of divers. Permanent deafness attributable to barotrauma is rare in deep sea divers. A method of diagnosis and conservative treatment of sinusitis and otitis media are discussed, and cases are cited. Pressure was increased in the pressure chamber to 5 or 10 pounds per square inch (360 to 700 Gm. per square centimeter) as tolerated by the patient. The pressure then was released and the relative higher pressure in the sinus or the middle ear induced drainage and relief of symptoms.

In a combined report from the Army Air Forces,[19] the use of radium in the treatment of aero-otitis due to lymphoid tissue in and around the orifice of the eustachian tube is discussed. Radium therapy has been found to be the most effective treatment for this condition. Most patients required 3 treatments at thirty day intervals. A total of 14,045 treatments were given. There were no instances of burn or ulceration. A small proportion of men had a mild sensation of a head cold after treatment. Of 636 men available for observation thirty days or more after completion of treatments, 74 per cent had less difficulty in ventilating their ears during flight and 89 per cent had a marked decrease of the amount of nasopharyngeal lymphoid tissue. The principal cause of failure to improve after irradiation of the lymphoid tissue was the presence of a large mass of adenoids. For the latter condition surgical removal should be combined with irradiation. Factors such as nasal allergy, chronic sinusitis and psychologic reactions were found to contribute to the lack of improvement of the ventilating ability of some ears. (Comment: The question of the relative advantages of radium locally applied and roentgen rays applied externally for lymphoid hyperplasia of the nasopharynx has not been satisfactorily answered.)

Fowler [20] discusses the various etiologic factors causing deafness in flyers and presents pathologic specimens showing lymphoid tissue, flaps of hypertrophied membrane, plugs of partially organized exudate in the eustachian tube and infection of the submucosa of the tube as possible causes of aero-otitis. Recurrent attacks of aero-otitis may produce fibrosis in the mucosa of the middle ear.

Canfield and Bateman [21] punctured the tympanic membrane with a needle in some instances of aero-otitis and found that the admitting of air directly into the tympanic cavity that was under reduced pressure resulted in prompt relief of all symptoms and that the drum healed without scar. (Comment: This appears to be an excellent treatment for severe acute aero-otitis.)

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19. The Use of Radium in the Aero-Otitis Control Program of the Army Air Forces, Ann. Otol., Rhin. & Laryng. **54**:650-724 (Dec.) 1945.

20. Fowler, E. P., Jr.: Causes of Deafness in Flyers, Arch. Otolaryng. **42**:21-32 (July) 1945.

21. Canfield, N., and Bateman, G.: Myringopuncture for Reduced Intratympanic Pressure, J. Aviation Med. **15**:340-343 (Oct.) 1944.

Kos [22] observed that changes of barometric pressure encountered in flying may produce not only a temporary loss of hearing for low tones but a greater loss for high tones above the 1024 level. In 94 instances the dips occurred most often at 1024, 5792 and 11584. Hundreds of flying personnel who have experienced aero-otitis media once or several times reveal no permanent impairment of hearing in the speech range.

Schilling [23] stated that 30 per cent of the men undergoing submarine escape training have aural difficulty leading to aero-otitis media when subjected to 50 pounds (27.5 Kg.) of air pressure in a recompression chamber. All ears showing severe damage have been found to have flattening of the eustachian orifices due to lymphoid hyperplasia and should be benefited by radium therapy. This condition has been noted to be associated with a depressed prepressure audiometric curve.

The effect of massive radiation on the ear was studied by Perlman.[24] Patients with carcinoma of the nasopharynx who had normal ears were treated with radiation, a considerable portion of which passed through the inner ear, and no changes in cochlear function were noted. In patients with carcinoma who had tubal obstruction due to the lesion and diminution of hearing, the hearing returned to its probable previous level when the tubal obstruction became relieved after irradiation passing in part through the cochlea. The effect of radiation on bony closure of perforations of the rabbit's cochlea was studied, and it was found that osteogenetic closure of these openings can be delayed somewhat but not prevented by radiation.

DEAFNESS DUE TO ACOUSTIC TRAUMA

Senturia [25] examined the auditory acuity of 500 aviation cadets by means of an audiometer before their training was begun. Thirty-three per cent showed a normal type A threshold curve, having a loss of not more than 10 decibels below the zero line at any frequency from 1024 to 11584. Tonal dips of the V type of 15 or more decibels occurred in 26 per cent. Twenty per cent of the ears had a type W curve, which has two tonal dips separated by an area of better hearing. Twenty-one per cent of the ears had an increasing loss for the higher tones—a type T curve. Only about 5 per cent had a loss of 60 or more decibels at one or more frequencies. Further studies were made as to the effects when these cadets were exposed to pure tones in the

22. Kos, C. M.: Effect of Barometric Pressure Changes on Hearing, Arch. Otolaryng. **41**:322-326 (May) 1945.

23. Schilling, C. W.: Aero-Otitis Media and Loss of Auditory Acuity in Submarine Escape Training, Arch. Otolaryng. **42**:169-173 (Sept.) 1945.

24. Perlman, H. B.: Radiation of the Ear, Laryngoscope **54**:255-266 (June) 1944.

25. Senturia, B. H.: Effect of Aircraft Noise on Hearing, Arch. Otolaryng. **41**:327-332 (May) 1945.

laboratory and when they were exposed to aircraft noise. The author found that temporary loss of hearing resulting from prolonged pure tone stimulation was not limited to the region of the fatiguing frequency but tended also to extend above this level. No losses were observed below it. The period of time necessary for recovery varied from a few minutes to a few weeks in different cadets. Auditory fatigue resulting from exposure to aircraft noise produced some loss in the low as well as in the high frequencies, but the maximum loss seemed to be usually at the 2048 cycle level. There was no tendency for one with a perceptive hearing loss to be unusually susceptible to auditory fatigue. To determine whether there was any permanent loss resulting from repeated exposure to aircraft noise, 40 cadets were examined after they had completed two hundred and ten hours of flight training. It was found that a small number of ears showed audiometrically a slightly increased V notching and high tone loss, but no ears showed any severe or unusual change in type or grade of hearing loss, and in no case did this interfere with hearing speech.

Boemer [26] observed that recovery from acoustic trauma caused by detonation of explosives reached its maximum in two months or less, and more readily in younger patients.

Machle [27] observed that acoustic trauma resulting from repeated daily exposure to gun blast was cumulative inasmuch as recovery was incomplete in twenty-four hours' time. After months of exposure, partial recovery was observed in only 2 of 10 men studied, and eventual recovery to preexposure levels was doubtful.

Lurie, Davis and Hawkins [28] exposed guinea pigs to pure tones of various frequencies at intensities from 140 to 157 decibels. Anatomic evidence of the damage done to the inner ear varied from disappearance of the mesothelial cells from the scala tympani surface of the basilar membrane to changes in the cells of the organ of Corti or its disruption and complete disappearance several days after exposure. The more extensive damage resulted from being exposed to the higher intensities for longer periods. It was followed by degeneration of the corresponding ganglion cells. No regeneration of damaged cells was noted. The electrical activity of the cochlea was impaired by exposures which caused anatomic changes in the organ of Corti. However, the parallelism was not always exact.

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26. Boemer, L.: Acoustic Trauma, Ann. Otol., Rhin. & Laryng. **54**:513-517 (Sept.) 1945.

27. Machle, W.: Effect of Gun Blast on Hearing, Arch. Otolaryng. **42**:164-168 (Sept.) 1945.

28. Lurie, M. H.; Davis, H., and Hawkins, J. E., Jr.: Acoustic Trauma of the Organ of Corti in the Guinea Pig, Laryngoscope **54**:375-386 (Aug.) 1944.

McCoy [29] compares the audiograms of workers who were preparing to start work in a shipyard with those made after they had worked a month in a noisy environment. All showed a 20 to 30 decibel loss above the 2000 cycle level. He points out that considerable noise could be eliminated in some industries by redesigning machinery or segregating noisy machinery from the general shop. Rubber stoppers have been shown to reduce the noise level 20 to 30 decibels. (Comment: This is a valuable and practical suggestion for the prevention of impairment of hearing due to occupational acoustic trauma.)

Taylor [30] points out that much money and effort have been spent in amplifying sound for the deaf but that relatively little has been done to insulate against excessively loud noises. The insulating value of cotton varies from 3 to 18 decibels. The recently developed Knudsen defender, made of soft synthetic rubber, reduces loud sound by 30 decibels and should reduce most explosive blasts to a harmless level.

Compensation for occupational deafness was investigated by Wilson.[31] Answers to a questionnaire sent to compensation boards revealed that 23 states recognized deafness as compensable if it was the result of an accident, but only 9 considered it compensable as an occupational disease. The author made some observations as to the degrees to which soldiers were susceptible to auditory fatigue when exposed to a pure tone for a given period. Of 30 soldiers who showed auditory fatigue after being exposed to a tone of 2048 cycles at 80 decibels for eight minutues, 25 had an elevation of the hearing threshold after returning from the firing range. Of the 78 who showed no auditory fatigue after the pure tone exposure, only 14 had a rise of threshold after being on the firing range. He believes that persons susceptible to auditory fatigue can be largely screened out by this method. The audiogram of a person exposed to a fatiguing tone of 2048 cycles shows a loss up to 4096 cycles.

In discussing the important aspects of aviation otology, Campbell [32] states that noise (a mixture of all frequencies) produces a notching of the audiogram at the 4000 level. This is reversible in the case of acute fatigue but is not reversible in that of chronic form. The drop in the audiogram may be considerable down to the 3000 level without affecting practical hearing. Susceptibility to acoustic trauma varies considerably in different persons. The problem of how to protect

29. McCoy, D.: Industrial Noise Hazard, Arch. Otolaryng. **39**:327-330 (April) 1944.

30. Taylor, H. M.: Problems of Prevention of Traumatic Deafness, Laryngoscope **54**:362-373 (July) 1944.

31. Wilson, W. H.: Prevention of Traumatic Deafness, Arch. Otolaryng. **40**: 52-58 (July) 1944.

32. Campbell, P. A.: Aviation Otology in World War II, Laryngoscope **54**: 387-397 (Aug.) 1944.

against noise in aviation has not been effectively solved. Emotion, as well as motion, seems to play an important part in airsickness.

DEAFNESS DUE TO BLAST INJURY

Silcox and Schenck [33] report their findings in 82 cases of blast injury of the ears. Rupture of the drumhead may lessen the degree of cochlear damage. Maximal recovery usually occurred in two weeks. Tinnitus persisted in 16 cases, being associated with a hearing loss predominantly of the higher frequencies. The degree of acoustic trauma varied directly with the length of the time of exposure and the intensity of the sound. Suppurative otitis media was present on the initial examination in 35 of the 82 patients. This high incidence was due to the conditions under which injury was sustained.

Henry [34] reported 292 cases of blast injuries of the ear and observed that two thirds of the patients would be expected to suffer no noticeable permanent defect. Of the remaining one third, the majority would be aware of some deterioration of hearing in one ear. A few would need a hearing aid, and a small percentage would require training in lip reading. Nearly all patients had a combination of conductive and perceptive deafness at the onset. As an audiometer was not available, the tests were carried out with tuning forks. The early tests showed a loss throughout the range from 128 to 12000 cycles, with more loss above 2000 cycles. Initially the greatest recovery was evident in the 128-2000 cycle range. Tinnitus occurred in one ear in 124 patients and in both ears in 48. Usually it lasted from a few days to a month, but in a minority it remained for several months. A single perforation occurred most frequently in the anterior-inferior quadrant, in the region of the eustachian tube. There was no tendency for the edges to be more frequently everted or inverted. It was therefore difficult to evaluate the effects of primary positive and negative secondary suction waves of the blast. Slightly more than half the patients had perforation of the drumhead. There was usually marked ischemia of the mucosa of the middle ear for nearly a week, and then the vascularity would return and the mucosa regain its natural color. In a number of ears there appeared to be desquamation of the outer layers of the skin of the outer two thirds of the canal.

Perlman [35] studied the effect of explosions on the fresh human conducting mechanism, using as a shock pulse that of a 32 caliber blank cartridge fired from a starting pistol. His observations indicated that

33. Silcox, L. E., and Schenck, H. P.: Blast Injury of the Ears, Arch. Otolaryng. **39**:413-420 (May) 1944.

34. Henry, G. A.: Blast Injuries of the Ear, Laryngoscope **55**:663-672 (Nov.) 1945.

35. Perlman, H. B.: Reaction of the Human Conduction Mechanism to Blast, Laryngoscope **55**:427-443 (Aug.) 1945.

the positive pressure wave of the incoming shock pulse is largely dissipated by the time it reaches the end organ and that the important traumatizing effect on the end organ comes from the negative phase of the induced oscillation. Rupture of the drumhead by the positive phase of the shock pulse lessens the amplitude of the negative phase and decreases the trauma of the end organ. The muscles of the middle ear offer no protection against the effects of a shock pulse, which usually has a duration of about 1 millisecond, inasmuch as the latent period of the stapedius tendon reflex is 10 milliseconds.

Cantor [36] advances a hypothesis as to the tympanic rupture occurring during a blast. He concludes that the positive pressure passes into the tympanic cavity through the eustachian tube and when pressure on the exterior of the body subsides the intratympanic pressure continues to be high for a fraction of a second longer and this difference in pressure causes the tympanic membrane to rupture outward in the anterior portion of the drum. The lesser cochlear damage in the event of drum rupture is explained on this basis, as the intratympanic pressure is released more rapidly after rupture of the drum, which diminishes the trauma exerted through the oval and round windows. This theory explains the observation that an ear with an obstructed eustachian tube is less likely to have rupture of the drum membrane. Previous theories have accounted for outward rupture of the tympanic membrane on the basis of a negative pressure phase following the initial positive phase. (Comment: Perlman's experiment [see the foregoing paragraph] suggests that Cantor's hypothesis is incorrect and that it is the negative phase following an explosion that causes rupture of the drum membrane. The valvelike action of the eustachian orifice closing it to any sudden increase in intrapharyngeal pressure [observed in rapid descents] should prevent an increase of intratympanic pressure unless the subject should happen to swallow or yawn at the moment of the explosion.)

DEAFNESS ASSOCIATED WITH SYSTEMIC DISEASE

Von Leden and Horton [37] investigated hearing in 50 cases of multiple sclerosis. Forty-two of the patients were under 40 years of age. Tests were made with a pure tone audiometer in a soundproof room. Forty-six per cent of the patients had a measurable degree of deafness in one or both ears. Of these 23 patients, 4 had slight losses of hearing along the entire range. Fourteen had slight to moderate losses of hearing for the high frequencies in one or both ears, and 5 had moderate to severe unilateral field defects (loss of 30 to 70 decibels). In no

36. Cantor, J. J.: Rupture of the Tympanic Membrane Due to Blast: Mechanical Hypothesis, Ann. Otol., Rhin. & Laryng. **54**:554-567 (Sept.) 1945.

37. Von Leden, H., and Horton, B. T.: Multiple Sclerosis: Study of Defects in Auditory Fields, Proc. Central. Soc. Clin. Research **17**:64-65, 1944.

case was the loss below 35 decibels for the speech frequencies. Only 8 patients of the entire group mentioned impaired hearing as a symptom. Only 4 of these 8 patients proved to have defective hearing. No diplacusis was noted. (Comment: Multiple sclerosis is one of the more rarer causes of impairment of hearing of central origin. It is not clear from the authors' article whether they regard the site of the hearing loss in their cases as being in the central nervous system or in the peripheral mechanism of the ear.)

Altmann and Dingmann [38] reported a case of congenital deafness and cataract following rubella in the mother during pregnancy.

MÉNIÈRE'S SYNDROME

Lindsay [39] reports on the histopathologic aspects of another case of Ménière's disease. The patient had been considered to have Ménière's disease three years before his accidental death, and a loss for high tones had been found in both ears as well as a 30 decibel loss for low tones in the left ear. This ear had also had a diminished response to a cold caloric test. Histopathologic examination showed hydrops of the left membranous labyrinth as compared with the normal right ear. Herniation of the utricle adjacent to the ampulla of the semicircular canal with distortion of the outer wall of the ampulla was noted in both ears. The clinical observation that vertigo comes on during an increase or a decrease of the deafness is compatible with this explanation since it is during a change in endolymph content in either direction that such a disturbance of the ampulla might occur. (Comment: So consistently has hydrops of the endolymph labyrinth been found in cases of Ménière's syndrome, that this condition may be named "hydrops of the labyrinth.")

The various etiologic concepts of Ménière's syndrome are discussed by Brunner.[40] He agrees that the symptoms are due to acute hydrolabyrinth which results frequently from angioneurotic disturbances of the internal ear. He believes that this may be associated with early or incipient arteriosclerosis of the brain. Other causes may be systemic, aural (e. g., chronic adhesive otitis), allergic—or the disease may be idiopathic. Treatment is chiefly that of the etiologic factors found. In the cases in which the cause is arteriosclerosis, rest, sedation, theobromine and calcium to decrease vascular permeability, a salt-poor diet and restricted intake of meat are helpful. Surgical intervention is rarely indicated. Intracranial lesions and neurosis simulating Ménière's disease must be excluded.

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38. Altmann, F., and Dingmann, A.: Congenital Deafness and Cataract Following Rubella in the Mother, Arch. Otolaryng. **42**:51-52 (July) 1945.

39. Lindsay, J. R.: Ménière's Disease: Histopathologic Observations, Arch. Otolaryng. **39**:313-318 (April) 1944.

40. Brunner, H.: Ménière's Syndrome, Arch. Otolaryng. **40**:38-43 (July) 1944.

Cawthorne and Hallpike [41] studied the vestibular function in cases of Ménière's disease before and after operation, by a modification of Bárány's caloric tests. With the patient's head elevated 30 degrees, each ear was irrigated for forty seconds with water at 30 and at 44 C. and the duration of the response was noted. If the response of one ear to both hot and cold was less than that of the other ear, it was termed canal paresis due presumably to an external semicircular canal lesion. If the tabulation of responses of the complete test on both ears showed nystagmus in one direction to be greater than that in the other, it was called directional preponderance, and the lesion was presumed to be utricular. Some lesions of the temporal lobe have also been known to produce directional preponderance. Of 100 patients with Ménière's disease tested, normal responses were found in 12 per cent, directional preponderance in 21 per cent, canal paresis in 49 per cent and a combination of the latter two in 18 per cent. In treatment, histamine was beneficial in one third of the cases. Other medical treatment employed consisted of $\frac{1}{600}$ grain (0.11 mg.) of hyoscine with $\frac{1}{150}$ grain (0.43 mg.) of hyoscyamine once to three times a day or a combination of $\frac{1}{2}$ grain (0.03 Gm.) of phenobarbital and $\frac{1}{12}$ grain (5.4 mg.) of pilocarpine, two or three times a day. In cases in which the condition failed to respond to conservative measures, the lateral semicircular canal was opened and the membranous labyrinth removed. All but 4 of 52 patients operated on have been definitely improved. (Comment: The surgical treatment of Ménière's syndrome is indicated in the occasional patient whose condition fails to respond to medical management or to improve as a result of spontaneous remission. The operation of Cawthorne or Day is to be preferred to intracranial section of the nerve as being safer and just as effective.)

Dandy [42] observed Ménière's disease in a man who was congenitally deaf and dumb. The attacks of rotary vertigo, accompanied with nausea and vomiting, were preceded by a noise in the right ear. There was a feeling of fulness in the right ear during the attack. An audiometric examination showed that some frequencies were interpreted as noises. Total section of the right eighth nerve gave complete relief of the vertigo, and there was also complete loss of perception for sounds previously interpreted as noises. At operation no porus acusticus of the usual type was found, and the auditory nerve was small and completely filled the opening. No previous cases have been reported in which Ménière's disease was associated with deaf-mutism.

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41. Cawthorne, T. E., and Hallpike, C. S.: Some Recent Work on the Investigation and Treatment of Ménière's Disease, Proc. Roy. Soc. Med. **36**:533-546 (Aug.) 1943.

42. Dandy, W. E.: Ménière's Disease in a Deaf-Mute, Arch. Surg. **50**:74-76 (Feb.) 1945.

Wright [43] reported treating 60 patients for Ménière's disease by injecting absolute alcohol through the footplate of the stapes. A special blunt needle was used, and 2 minims (0.12 cc.) of alcohol was injected into the vestibule. Of 60 patients, 55 were relieved as to vertigo and 33 as to tinnitus. In 2 patients facial paralysis—permanent in one—and in 1 patient pneumococcic meningitis developed a few months after the injection. (Comment: The surgical destruction of the labyrinth according to the technic of Day or of Cawthorne is probably to be preferred to the injecting of alcohol through the stapedial footplate because the latter technic endangers the facial nerve.)

Mogan and Baumgartner [44] felt that Ménière's disease is a vasomotor disturbance caused either by blood-borne irritants affecting the sympathetic nerves to the part or by metabolites of local tissues acting on the same nerves. The actual mechanics of the condition are those causing serum to be extravasated into the scala media. The authors offer a further report on a patient with Ménière's disease and recurrent interstitial keratitis who was operated on in 1937 for removal of the superior cervical ganglions, including the trunks from the midcervical ganglions. The patient has had no further vertigo, and the hearing has not decreased further.

Results obtained in treating what he has classed as the vasoconstrictor group of symptoms of Ménière's disease with nicotinic acid are further reported by Atkinson.[45] He cautions that treatment must be intensive, beginning with the intravenous and intramuscular routes. Maintenance therapy must frequently be carried out indefinitely. Eighty-four per cent of 110 patients so treated obtained either partial or complete relief of vertigo. Tinnitus was improved in 40 per cent and completely removed in 12 per cent. Deafness was reduced in 21 per cent and hearing restored in 2 per cent.

Lillie, Horton and Thornell [46] review the etiologic and therapeutic aspects of Ménière's symptom complex. They report the results they obtained in 25 cases with intravenous administration of histamine diluted with either isotonic solution of sodium chloride, dextrose solution or 0.8 per cent potassium chloride solution. The deafness was improved in 12 cases, especially in those who were given histamine in potassium

43. Wright, A. J.: Ménière's Disease: Results of Treatment of Sixty Cases by Alcohol Injection Through Foot-Plate of Stapes, J. Laryng. & Otol. **59**:334-341 (Sept.) 1944.

44. Mogan, R. F., and Baumgartner, C. J.: Ménière's Disease, Arch. Otolaryng. **41**:113-116 (Feb.) 1945.

45. Atkinson, M.: Ménière's Syndrome, Arch. Otolaryng. **40**:101-107 (Aug.) 1944.

46. Lillie, H.; Horton, B., and Thornell, W.: Ménière's Symptom Complex: Observations on the Hearing of Patients Treated with Histamine, Ann. Otol., Rhin. & Laryng. **53**:717-741 (Dec.) 1944.

chloride solution. Improvement was noted in tinnitus in 14 cases and in vertigo in 21 cases.

Lawhorn [47] has injected intravenously 4 to 5 cc. of 50 per cent magnesium sulfate for Ménière's syndrome, with satisfactory results. The drug is given at two sites, 2.5 cc. at each, in two and one-half minutes. He points out that an intravenous overdosage of magnesium sulfate can be fatal. One cubic centimeter of 5 per cent calcium gluconate should be available to be used to counteract any undesirable effect of the magnesium sulfate.

Day [48] reports operating on the labyrinth in 8 cases of Ménière's disease in which the condition had not responded to conservative measures. The external semicircular canal was exposed through a postauricular approach. The canal was opened just medial to the short process of the incus, a needle was passed through this opening to the ampulla, withdrawn slightly and a light coagulating current applied two or three times for one second. The time elapsed since operation in 6 of the 8 cases was from one to three years. Six patients with unilateral involvement were relieved of their attacks of vertigo. Two patients with bilateral involvement were not relieved of vertigo by the surgical treatment. As to hearing, 2 patients lost the hearing in the surgically treated ear completely; in 2 it was unchanged; 3 showed further loss, especially for lower tones. In 1 patient who had a preoperative loss of 70 decibels, the hearing returned almost to normal.

Goodyear [49] reported having operated on several patients for Ménière's disease by an approach similar to that described by Day, but with no attempt to disturb the utricle. Satisfactory results were obtained in most instances.

MISCELLANEOUS CONTRIBUTIONS ON CAUSES AND TREATMENT

Lurie [50] discussed the problem of deafness in general and concluded that the only type of chronic deafness for which the otologist could offer any hope to the patient was the conductive type if the cause could be found and corrected; or, as in the case of clinical otosclerosis, fenestration could be done. No effective treatment has been found for nerve deafness. Rehabilitation is the best that can be offered to patients with this type of deafness. (Comment: In general the author is correct in pointing out that as a rule nerve deafness is not amenable to treatment, while the patient with conduction deafness can frequently be

47. Lawhorn, C. C.: Treatment of Ménière's Syndrome, M. Rec. **157**:220 (April) 1944.

48. Day, K. M.: Surgery of the Labyrinth for Ménière's Disease, Tr. Am. Acad. Ophth. (1943) **48**:221-230 (March-April) 1944.

49. Goodyear, H. M.: Surgical Approach to the Labyrinth in Ménière's Disease, Ohio State M. J. **40**:944-945 (Oct.) 1944.

50. Lurie, M. H.: Deafness: Its Cause and What Can Be Done About It, Arch. Otolaryng. **42**:144-146 (Aug.) 1945.

helped by treatment. However, there are occasional rare cases of nerve deafness in which hearing can be improved. These are: nerve deafness due to allergy, nerve deafness due to drug intoxication [removal of the drug results in partial or complete recovery], nerve deafness due to acoustic trauma [cessation of the trauma results in partial recovery].)

Quisling [51] advocates using cold over the mastoid process (hypothermic therapy) in eighth nerve and otosclerotic deafness. He stated that the treatment produces first a vasoconstricting action, then vasodilatation. He has induced paracusis willisiana by cold as well as by vibrating means. He claims 70 per cent good results in cases of eighth nerve irritation. (Comment: A bizarre and illogical treatment entirely without satisfactory audiometric proof.)

Trowbridge [52] reports some improvement in hearing and relief of tinnitus from intratympanic injection of ethylmorphine hydrochloride in cases of conductive deafness due to scar tissue of the middle ear resulting from past suppuration. This drug was selected because of its value for removing pupillary exudates and absorbing interstitial corneal deposits. A hearing improvement of 10 to 15 decibels was obtained in 18 or 22 cases. In 9 cases there was associated tinnitus, which was lessened in 6.

Vastine [53] tested vestibular response and residual hearing in 208 pupils at the Pennsylvania School for the Deaf. Vestibular function was normal in 24 per cent, subnormal in 57 per cent and absent in 19 per cent. In general the degree of activity of the static labyrinth was somewhat parallel to the activity of the acoustic labyrinth, with the exception of the cases in which there was involvement due to meningitis. The static labyrinth in the latter cases (16 in the series examined) was always partially or completely inert. The acquired lesions seemed to be more profound than the congenital.

Fowler [54] reports 2 cases of complete monaural deafness for speech with flat threshold audiograms for the most important speech frequencies down only to the 45 to 50 decibel level in the affected ear, the opposite ear being normal. He believes that the lesion must in part, at least, be central to the end organ. A psychologic exclusion of the deafened ear to speech is also a possibility. (Comment: The author's suggestion of the possibility of unilateral psychologic deafness is inter-

51. Quisling, S.: Treatment of Deafness, Ear Noises and Dizziness by Hypothermic Therapy, Journal-Lancet **65**:219-221 (June) 1945.

52. Trowbridge, B. C.: Injection of the Tympanum for Chronic Conductive Deafness and Associated Tinnitus, Arch. Otolaryng. **39**:521-524 (June) 1944.

53. Vastine, M.: Correlation Between Vestibular Function and Hearing in the Profoundly Deaf Child, Arch. Otolaryng. **39**:164-171 (Feb.) 1944.

54. Fowler, E. P.: Total Monaural Deafness for Speech, but not for Speech Frequencies, Laryngoscope **54**:605-615 (Nov.) 1944.

esting. Formerly psychologic deafness was regarded as a most rare condition, occurring only binaurally.) The causation of unilateral deafness is considered by Hughson [55] with special attention to virus diseases. Complete unilateral deafness, usually without vestibular involvement, may result from clinical or subclinical epidemic parotitis. Specific mumps antibodies may be found in people who have no history of a known attack. He points out that some persons with unilateral deafness and a negative history of any specific infection being related to the deafness may have had subclinical mumps or some other virus disease. Intracranial lesions must always be considered and ruled out.

A case of bilateral acoustic neuritis is reported by Johnson.[56] Loss of hearing in the right ear started with an attack of tonsillitis. The onset of deafness of the left ear occurred several weeks later. Serologic, roentgenographic and spinal fluid findings were normal. Caloric tests showed a diminished response of the right ear and a normal response of the left. There was no vertigo. Complete deafness eventually developed.

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55. Hughson, W.: Unilateral Deafness, Laryngoscope **54**:467-481 (Sept.) 1944.

56. Johnson, M. R.: Bilateral Acoustic Neuritis, Arch. Otolaryng. **40**:261-265 (Sept.) 1944.

Abstracts from Current Literature

Ear

STIFFNESS LESIONS OF THE CONDUCTING MECHANISM. H. B. PERLMAN, Laryngoscope **56**:497 (Sept.) 1946.

Various methods have been used to measure the stiffness of the conductive mechanism. In general they consist in producing varying degrees of pressure, positive and negative, on the tympanic membrane while a sound of constant intensity is delivered to the ear. Changes in the pressure on the membrane cause the patient to hear the sound more loudly, less loudly or not at all. Such changes in hearing will differ with different lesions of the conductive mechanism. Study of these changes enables one to evaluate better the function, whether normal or pathologic, of the middle ear and eustachian tube.

Perlman devised his own apparatus for this work. He describes it in detail.

HITSCHLER, Philadelphia.

DIAGNOSIS AND EVALUATION OF FENESTRATION. T. E. WALSH and S. R. SILVERMAN, Laryngoscope **56**:536 (Sept.) 1946.

The authors describe in detail the methods they use in order to determine whether or not a patient should be treated by fenestration and just what benefits he will obtain.

History, age and type of voice are carefully considered, and then certain tests are performed. These tests include the usual audiometric tests and, in addition, articulation tests. It is pointed out that the pure tone audiometric tests have their limitations, and in order to foretell just how much the operation will achieve, articulation tests are necessary. The methods of performing them and the apparatus necessary are described. Illustrative case reports are included.

HITSCHLER, Philadelphia.

THE COURSE OF OTITIC FACIAL PALSY UNDER ADEQUATE TREATMENT OF THE DISEASE OF THE EAR. WHEN IS A BALLANCE-DUEL OPERATION INDICATED? KAESTEN KETTEL, Acta oto-laryng. **34**:311 (July-Aug.) 1946.

The greatest difficulty in cases of facial palsy is that of determining in which cases recovery will occur spontaneously and in which it will not. In England and America the absence of the faradic response is used as an indication that operation is necessary, but Kettel believes that a negative faradic response does not preclude spontaneous recovery, because in a palsy of some duration the stimulation is inadequate to produce much contraction, as it is of too short a duration. The only conclusion which can be deducted from absence of a faradic response is that the issue is doubtful, and if decompression of the nerve were done in every case of this type, there would be many superfluous operations.

This report of Kettel is based on a reexamination of a series of 264 patients referred from the Municipal Hospital in Copenhagen, Denmark, distributed over a period of thirty years, with whom a conservative form of treatment was used. Of this series of 264 patients, 169 were still alive and were personally examined by Kettel.

For some groups of facial palsies, Kettel holds, a Ballance-Duel operation must be done immediately; for others he advocates an observation period of two months because in all of his cases of otitic palsy in which the patient regained mimicry completely, the first sign of returning mobility was noted within this time limit. Patients in whom movement began after this time limit did not completely recover spontaneously, and in such cases decompression should be done.

Kettel lists four types of otitic palsy and gives the operative indications in each:

1. For preoperative palsy accompanying acute otitis, he believes, the prognosis is good if the suppuration of the ear is treated adequately. Palsy associated with the early stages of acute otitis media does not immediately call for mastoidectomy. If the palsy increases or does not decrease after some time in spite of the fact that pus is draining freely through the canal, then mastoidectomy should be performed. Of course, it should also be done if other indications are present. If, however, the facial palsy appears late in the course of the otitis media, mastoidectomy should be performed. After the mastoidectomy has been done, decompression of the nerve should be done only if there is no evidence of improvement in the palsy in two months' time.

2. For preoperative palsy in a patient with chronic otitis media, radical mastoidectomy should be done. If a fistula of the fallopian canal is found, the nerve should be decompressed. The fistula should be enlarged until every sign of osteitis is gone and the nerve, after the sheath has been split, looks normal. Of 27 patients with preoperative palsy in association with chronic otitis in whom decompression was not done, 7 showed complete and 9 partial clearing up; in 11 the paralysis remained complete. Kettle's conclusion as to such cases is that after radical mastoidectomy has been done the palsy should be kept under observation, and if there is no sign of returning function in two months, decompression of the nerve should be practiced.

3. For postoperative palsy occurring in direct connection with mastoidectomy, Kettel, in conformity with Ballance and Duel, advises immediate decompression (with eventual nerve grafting or suture of the nerve, according to the nature of the lesion). While he agrees with others that it does not make much difference in the end result if a number of months (up to eighteen) elapse before the decompression is done, he calls attention to the great difficulty of finding the ends of the severed nerve after this lapse of time. Furthermore, the condition of the facial muscles becomes less satisfactory with the passage of time.

4. For postoperative palsy occurring after a free interval, the prognosis for spontaneous recovery is relatively good. If the palsy occurs in the first few postoperative days, it is due to pressure of packing or to hemorrhage in the canal. In cases of this type the condition can be treated expectantly, but the nerve should be decompressed if there is no evidence of returning function in two months.

Another variety of postoperative facial palsy may not appear until several weeks after the operation and it will be due to progressing osteitis. However, in cases of this type pus and granulations will be found near the facial ridge. These cases call for a revision of the radical mastoidectomy followed by a two months' observation period.

GROVE, Milwaukee.

Pharynx

THE USE OF PENICILLIN IN ACUTE SORE THROAT. SELVAN DAVISON, J. A. M. A. **131**:1050 (July 27) 1946.

Davison discusses the bacteriology of acute follicular and exudative tonsillitis and pharyngitis, reviewing briefly the effects of sulfonamide preparations, but emphasizing the greater efficacy of penicillin. He outlines the methods of therapy used in observing a number of cases. He summarizes and concludes as follows: Twenty-eight patients were treated with penicillin for acute sore throat (including 1 patient who had pharyngotonsillar diphtheria). The dose of penicillin employed was 20,000 units, given every three hours day and night. The average dose of penicillin in 27 cases of acute sore throat was 360,000 units over fifty-four hours. (This does not include the case of diphtheria.) There was one relapse, in which recovery occurred without further penicillin. One patient's condition did not respond until sulfadiazine replaced penicillin in the treatment. No complications occurred, either during or after treatment. A short but intensive course of penicillin would seem to be effective against acute sore throat, and further investigations along these lines are warranted.

GORDON, Philadelphia.

A Review of the Available Literature on the Pharynx and Pharyngeal Surgery for 1944. Francis E. LeJeune, Laryngoscope **55**:465 (Sept.) 1945.

Derbes and Engelhardt discuss the use of local anesthetics. Clift presents a new radium applicator with advantages not present in others. The shaft bears an adjustable metal disk that aids in keeping it in proper position. Szanto describes ways of removing the nasopharynx at autopsy. Retropharyngeal abscess is discussed by Weille and De Blois, who may have seen 27 cases in the past fifteen years. Several articles are reviewed, on the anatomy, the histology and the bacteriology of the larynx and the pharynx. Cancer and other neoplasms are discussed.

Hitschler, Philadelphia.

Larynx

Reinnervation of a Paralyzed Vocal Cord. Julius W. McCall and Normand L. Hoirr, Laryngoscope **56**:527 (Sept.) 1946.

McCall and Hoirr propose a method for inducing regeneration of the recurrent laryngeal nerve by creating an anastomosis between it and the vagus nerve. Their work was done on experimental animals.

Injury or section of the recurrent laryngeal nerve occurs mostly as a result of thyroid disease or thyroidectomy. Previous attempts to obtain relief of bilateral abductor paralysis of the vocal cords entailed a certain amount of mutilation of the larynx. McCall and Hoirr avoid this by making an anastomosis between the vagus and the injured recurrent laryngeal nerve peripheral to the lesion. The problems entailed in this procedure and the operative details are discussed by the authors.

Protocols of four typical experiments are given. In three of these motion was restored to the involved vocal cord.

Hitschler, Philadelphia.

Feeding Tube Stenosis of the Larynx. P. H. Holinger and W. J. Loeb, Surg., Gynec. & Obst. **83**:253 (Aug.) 1946.

In the presentation of 4 cases of laryngeal stenosis that followed the postoperative use of an indwelling nasal tube, the authors state that erosion of the anterior esophageal wall at the cricoid level was followed by subsequent inflammation of the laryngeal cartilages and ultimate necrosis. Symptoms began with local discomfort and progressed to include sore throat, pain radiating to the ears, pain on swallowing, hoarseness and dyspnea. Tracheotomy was necessary in 3 patients four to five weeks after removal of the stomach tube. Severe chronic laryngeal stenosis developed in these 3 patients. The fourth patient died of carcinomatosis, and postmortem examination demonstrated an ulcer which had not yet caused laryngeal destruction.

Treatment consists in removing or altering the position of the feeding tube when the symptoms mentioned develop. Chemotherapy, tracheotomy, drainage, laryngeal dilatation and plastic repair comprise the active measures necessary.

Friedberg, Chicago.

Further Experiences with Panlaryngectomy for Advanced Carcinoma of the Larynx. A. Brunschwig and J. R. Lindsay, Surg., Gynec. & Obst. **83**:639 (Nov.) 1946.

The operation proposed by Brunschwig in 1943 for advanced carcinoma of the larynx consisted of "en masse resection of the larynx, base of the tongue, upper portion of the trachea, and upper portion of each thyroid lobe and the anterior portion of most of the cervical esophagus." The procedure was recommended for patients in whom metastases had not extended beyond the cervical lymph nodes. The latter are removed in the block dissection described, and, if involved, the

jugular veins may also be included. The observations on a second group of 7 patients subjected to this procedure are analyzed by the authors. Improved results were evident in the increased survival time and the decreased incidence of recurrences. No immediate surgical mortality is reported in the series. One patient of the first group reported in 1943 is alive and well seven years after surgical intervention. Among the 7 living patients of the present report, two years is the upper limit of survival without recurrence. "Appreciable palliation" and prolonged control of the disease are afforded by the operation, according to the authors.

FRIEDBERG, Chicago.

Nose

FRONTAL SINUS DRAINAGE. O. E. VAN ALYEA, Ann. Otol., Rhin. & Laryng. **55**:267 (June) 1946.

Frontal sinusitis generally heals spontaneously within seven to ten days, but occasionally the infection persists until something is done to improve drainage. In some cases persistence of infection may be due to the unusual virulence of the organisms or to some factor which markedly lowers the host's resistance. In most cases, however, the inflammation persists because of some structural defect preventing free drainage. In those cases in which it persists despite an open ostium, drainage is impaired because the middle meatus is blocked or because an ethmoid or frontal cell encroaches on the drainage space. There are cells either in the lumen of the sinus or encroaching on one of its walls, at least unilaterally, in 50 per cent of persons, and in a third of these the encroachment is in the neighborhood of the frontal ostium. Such cells may well be the sole reason why an infection progresses to a chronic state. The middle meatus is most often blocked because the middle turbinate is impacted against the lateral nasal wall, but the blocking may also be due to a cell of the turbinate, polyps or even a thin nose. In many cases frontal sinusitis will clear up with infraction of the middle turbinate or crushing of a cell of a turbinate or removal of polyps. In others the condition improves with shrinkage of the mucosa, and in some, with displacement therapy and mild suction. In those cases in which the condition does not improve following such therapy irrigation of the sinus is indicated. In most cases any harmful effects of the trauma incident to the probing are far outweighed by the benefit derived. The cases in which the sinus does not do well with irrigation are those in which the condition is of a severe toxic nature with fever and in which local immunity has not been developed. In this type the patient should be kept in bed, heat applied locally, anodynes given freely and proper vasoconstrictors instilled into the nose on the affected side. As the patient becomes afebrile and local resistance develops, local intranasal measures may be used. Should the symptoms become more severe and danger of complications develop, external drainage should be obtained through a small opening in the floor, the accumulated secretion withdrawn by suction and the sinus irrigated with warm saline solution or let alone, but the mucosa and the ostium are not tampered with. Chemotherapy is indicated in addition.

A prolonged case of acute involvement implies faulty drainage, with likelihood that the disease will recur or become chronic. It is important that structural defects be corrected, and corrective measures may be introduced during or following an acute attack. All the patients should be studied with allergy in view. Coexisting infection of other sinuses should be eliminated. Special care must be taken in examining for cells encroaching on the lumen of the frontal ostium and roentgenography, with iodized oil being used, may be necessary. Many of these encroaching cells can be broken down by mere passage of a cannula.

In cases of chronic frontal sinusitis most patients may be greatly helped, and many cured, by removal of the barriers to drainage. Radical operation with removal of the mucosa does not bring uniformly good results, and in most cases

the removed mucosa shows no changes other than those of chronic inflammation. This membrane functions as a defense mechanism, and even though it may be thickened and irregular, it is functioning to the best of its ability in a poorly draining cavity and should be protected rather than destroyed.

The author says that the external approach should be reserved for (1) cases with annoying symptoms which have resisted all available conservative measures, (2) the release of pus that is under pressure and threatening complications, (3) removal of cells and growths within the sinus encroaching on the ostium and (4) cancer and inflammatory conditions with involvement of bone.

M. V. MILLER, Philadelphia.

NASAL PHYSIOLOGY IN RELATION TO THE COMMON COLD. ARTHUR W. PROETZ, Ann. Otol., Rhin. & Laryng. **55**:306 (June) 1946.

Proetz discusses the development of colds and feels that whether or not they develop depends on whether the infecting organisms, floating on the mucous blanket of the nose, can penetrate the latter and come in contact with the underlying cells for sufficient time to involve these cells. He cites four agencies which determine whether penetration occurs, or does not. Two of them, (1) structural mechanical obstruction and (2) drying, act directly on the mucosa; the other two, (3) functional mechanical obstruction and (4) biochemical stasis of the mucous blanket, act remotely.

As to the first-named agency, a deviated septum, a hyperplastic turbinate, an adhesion, a polyp or a scar may block the passage of the mucous blanket and arrest bacteria long enough to permit penetration. If the organism is virulent, severe infection takes place but is usually local. The obstruction being fixed, there is frequent recurrence and the area subsides into being a chronic nuisance rather than a source of colds.

Regarding the second agency—drying—concentrated jets of dry air can cause destruction of the ciliated cells, and at this point of stasis of the mucus the bacteria have a chance to invade. Drying at various points is caused by restricted or distorted airways that project air in concentrated streams. Restrictions or distortions may be produced by fixed nasal abnormalities or by sudden vascular swellings and obstruction.

Functional mechanical obstruction, the third agency, is the most common cause of endemic winter colds, and the process develops in stages: (*a*) Sudden chilling fatigue, constipation, hunger, excitement or alcohol may upset the sympathetic system. (*b*) The nasal erectile tissues susceptible to vasomotor stimuli react, obstruction and diversion of air currents develop and the dry air makes burning dry spots, but there is still no cold. (*c*) The stasis permits accumulation and growth of bacteria at a point where lymph glands are superficial and susceptible. Systemic toxic symptoms appear. The vasomotor system is now doubly upset, the nose blocks tight, there is nasal retention of any organism present and the cold is in full swing. As the burning sensation takes place some twenty-four hours before the development of the nasal disturbance, that signal gives time to adopt measures to abort the attack. Treatment depends on the reestablishing of normal conditions as quickly as possible and scrupulously avoiding any measures which will upset the still functioning nasal mechanism. One can easily wreck the whole procedure by irrigating away the highly essential mucus or applying strong constrictors which increase the nasal caliber and therefore the stickiness and unmanageability of the mucus in the nasopharynx.

Fourth, there may be a direct attack by a presumably soluble biochemical agent which at once incapacitates the cilia. Virus infections may well be of this nature.

Inasmuch as the interference with ciliary action and the mucous blanket seems to be the main factor in the development of colds, an investigation of how this is brought about is likely to open the way to a more effective way of preventing colds.

M. V. MILLER, Philadelphia.

Miscellaneous

ACUTE SUPPURATIVE PAROTITIS IN A NEWBORN INFANT. HENRY A. REISMAN and GOLDA FISCHER, Am. J. Dis. Child. **71**:387 (April) 1946.

This condition probably occurs more frequently than reports in the literature indicate. It is not exclusively a disease of adults and is by no means rare in the newborn. Mortality is high, however, and therefore the authors report their case because the patient made a "complete and uneventful recovery."

A 9 day old white boy was delivered at the eighth month. He weighed only 4 pounds (1,814 Gm.). The mother had frequent uterine hemorrhages during the entire period of gestation, resulting eventually in this spontaneous delivery. The baby was cyanotic and required careful nursing and continuous administration of oxygen. On the ninth day there was a profuse purulent exudate coming from the right ear with a swelling of the right side of the face conforming to the entire parotid area, pressure on which forced exudate into the auditory meatus and through Stensen's duct. Pus taken from the incision and from the canal showed hemolytic Staphylococcus aureus. Recovery took place after forty days.

In infections of the parotid glands three organisms are usually found: Staphylococcus aureus, Streptococcus viridans and Pneumococci in that order. Those with Str. viridans are likely to recur. Simultaneous pressure and observation of Stensen's duct make the diagnosis, but confusion may occur as to sialolithiasis, tumor, congenital enlargement of the parotid glands, preauricular adenitis and Mikulicz disease.

Treatment is carried on with hot compresses, general supportive measures, penicillin and chemotherapy.

VOORHEES, New York.

TRAINING AND CERTIFICATION OF SPEECH CORRECTIONISTS. SEVERINA E. NELSON, J. Speech Disorders **11**:205, 1946.

A questionnaire was sent to various institutions giving professional training in the field of logopedics. Some schools arrange a four year specialized curriculum with a systematic arrangement. Others believe it is possible to keep the traditional curriculum intact and to integrate with it or superimpose on it a professional course of study. A third group arranges a five year program. A similar emphasis is placed on certain specialized courses. The question whether the training program should include four years of general cultural courses and a fifth year of specialization is still to be answered. Professional standards as used and interpreted by state certifying agencies should be brought up to association requirements comparable with those offered in the American Speech Correction Association. Courses in specialization should be studied against the background of the general course of study for the proper perspective. Too few speech correctionists are being trained and certified for the urgent need in school systems, probably owing to lack of state support and understanding of the problems of training. Support and help should be given to those institutions with curricular programs who are struggling without university support and understanding and without state aid.

PALMER, Wichita, Kan.

BENZHYDRYL ETHER HYDROCHLORIDE (BENADRYL) IN THE SYMPTOMATIC TREATMENT OF ALLERGY. EMANUEL SCHWARTZ and LOUIS LEVIN, New York State J. Med. **46**:1233 (June 1) 1946.

Working in the division of allergy of the department of medicine of the Long Island College Hospital, the authors report on the use of this "benzhydryl alkamine ether." It is a histamine-like substance produced by synthesis. In theory the wheal-producing allergies are dependent for this action on antigen and antibody uniting in the shock tissues, thus liberating histamine.

Fifty patients were treated with "benadryl." "Symptomatic relief" was secured in 8 of 20 cases with asthma (40 per cent); in 6 of 10 with vasomotor rhinitis (60 per cent); with varying success up to 100 per cent in those with acute urticaria. Within one hour after administration the patients reported benefit, but the symptomatic relief was palliative. Various "side reactions" occurred in 30 patients, chiefly drowsiness and disturbed orientation, but dizziness, tinnitus, nervousness and vomiting also were manifested. However, some of these symptoms disappeared while the patients were continuing to use the drug; others, when the patients stopped its use.

The authors conclude "that Benadryl was an effective drug in the symptomatic relief in 29 of the 50 (58 per cent) allergic patients." VOORHEES, New York.

THRUSH AS SEQUEL TO PENICILLIN TREATMENT. EUGENE E. MARCOVICCI, New York State J. Med. **46**:1361 (June 15) 1946.

The author reports 6 cases in which untoward reactions occurred "among many cases of various infections." The mildest were in cases of aphthous stomatitis in which penicillin was administered orally. The severest were urticaria with giant wheals and angioneurotic edema of face, hands and feet following parenteral injection of the sixth dose of 20,000 units during an infection of the upper respiratory tract. Four patients suffered "the painful experiences associated with thrush."

Marcovicci "wonders" whether or not penicillin reduces the resistance of oral mucous membrane to organisms already present in the mouth, thus allowing them to get to work. However, in all these patients nutrition was good, and they were taking a well controlled, balanced diet. In 2 patients with pneumonia there was long-lasting fever which may have been due to "contamination." It would be well to have control observations as to the concurrent growth of Pennicillium notatum and Oidium albicans.

Treatment of the lesions of the mouth consisted in painting with 1 per cent gentian violet medicinal, preceded by irrigations with alkaline solutions and gargles with a 2 per cent solution of sodium bicarbonate.

VOORHEES, New York.

INJECTION OF FORTY PER CENT IODIZED POPPYSEED OIL IN THE SALIVARY GLANDS. LOUIS LEROUS and CHEVALIER, Ann. d'oto-laryng. **12**:457 (Oct.-Dec.) 1945.

Lerous and Chevalier describe a technic by which iodized oil is injected into the salivary glands.

They feel that sialography does not generally give conclusive information because of failure of technic and the infrequency of its use.

This diagnostic procedure is valuable in the recognition of chronic inflammatory tumefactions whether the lesions are canalicular or parenchymatous. It may be used in the differential diagnosis of chronic catarrhal inflammation, tuberculous involvement, adenitis and new growth. Despite the difficulties involved, the use of radiopaque substances should be attempted. The injection of oil is without danger, gives a good outline of the canals and the glands and permits more accurate diagnosis.

Theoretically, the technic is simple, but at times it is impossible to inject the involved gland.

The instrumentarium consists mainly of surgical silkworm gut, very small-sized lacrimal duct probes and a strong syringe that will withstand pressure and is fitted with a lacrimal duct adapter and cannula. Good vision is essential. The technic of the injection of Stensen's and Wharton's ducts is described, and roentgenographic illustrations are presented. VIOLÉ, Los Angeles.

THE RETROAURICULAR APPROACH TO THE TEMPOROMAXILLARY ARTICULATION. M. AUBRY and E. BOURDON, Ann. d'oto-laryng. **12**:465 (Oct.-Dec.) 1945.

1. The advantages of this technic are: (*a*) The facial and the parotid nerve are not subject to direct injury. (*b*) A wide and free exposure of the articulation is obtained. (*c*) This approach is direct, while the preauricular incisions give an oblique access from above downward. (*d*) Finally, this route eliminates unsightly scars and gives a better esthetic result, as the incision is hidden behind the ear.

2. This method is simple if the technic is rigorously followed. (*a*) It is essential that the auditory canal be sectioned far away from the bony canal and as close as possible to the external auditory meatus. (*b*) The auditory canal must be sutured in two stages: first by subcutaneous and cartilaginous sutures; second by cutaneous sutures.

By this technic, stenosis of the external auditory canal is avoided, the inconveniences of which are all too well known.

The various steps of this procedure are well described and illustrated.

VIOLÉ, Los Angeles.

FORTY CERVICAL WAR WOUNDS (NECK AND NAPE). PAUL ABOULKER, Ann. d'oto-laryng. **12**:488 (Oct.-Dec.) 1945.

Aboulker reports 40 war injuries which he had under observation in a field hospital in Italy and France for over a period of one year.

In the course of 1,500 general operations only 30 wounds of the neck and 10 of the nape were encountered. It has been concluded that this relative infrequency may be attributed to: (1) the use of the helmet, (2) the movements of the shoulder and head and (3) the protection afforded by the lower jaw.

Because of these protecting factors the author believes that the neck is less susceptible to injuries.

He gives descriptions of the various cervical injuries and of their management and after-care.

VIOLÉ, Los Angeles.

News and Comment

ARMY MEDICAL LIBRARY MICROFILM SERVICE

During the war the Army Medical Library through its photoduplication services supplied millions of pages of microfilmed medical articles to the armed services and other research agencies. The principle of this rendering of immediate direct aid to the user, wherever he might be, introduced a new technic to medical research.

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Book Reviews

Fundamentals of Clinical Neurology. By H. Houston Merritt, M.D.; Fred A. Mettler, M.D., and Tracy Jackson Putnam, M.D. Philadelphia and Toronto, Canada: The Blakiston Company, 1947.

This is a small book of about 300 pages on clinical neurology. Its purpose of outlining a technic of neurologic examination and pointing out the significance of each finding briefly is excellently accomplished.

The important steps in making an examination are outlined. It begins with the history, the means of examination, the cranial nerves, the motor system and the sensory system and then considers anatomic diagnosis with regard to each part of the nervous system. Clear language is employed, leaving no question as to the meaning of the authors. No point of examination is recorded without stating then and there the significance of the findings. The topics of clinical importance are headlined in bold type, and their divisions immediately follow. About 100 figures and drawings, many in color, clearly facilitate the understanding of the topics.

To an experienced neurologist this outline may mean merely a review of the subject matter he already knows but one which could form a valuable guide in teaching. To others—for example, internists, otolaryngologists and ophthalmologists, who frequently are concerned with the relation of the central nervous system to their work—this book is an illuminating guide. It not only supplies important information but does so clearly and briefly, wasting neither one's time nor one's energy. It makes a so-called difficult subject a reading pleasure.

Directory of Otolaryngologic Societies *

INTERNATIONAL

First Pan-American Congress of Oto-Rhino-Laryngology and Bronchoesophagology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Chevalier L. Jackson, 255 S. 17th St., Philadelphia 3.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.
Secretary: Dr. J. Milton Robb, 1553 Woodward Ave., Detroit, Mich.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Alan C. Woods, Johns Hopkins Hospital, Baltimore 5.
President-Elect: Dr. C. H. McCaskey, 20 N. Meridian St., Indianapolis, Ind.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100–1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 12-17, 1947.

American Broncho-Esophagological Association

President: Dr. Millard F. Arbuckle, 539 N. Grand Blvd., St. Louis.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.

American Laryngological Association

President: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia 2.
Place: Old Homestead, Va. Time: April 14-15, 1948.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Lyman G. Richards, 15 Whiting Rd., Wellesley Hills, Mass.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Chalfonte-Haddon Hall, Atlantic City. Time: April 7-9, 1948.

SECTIONS:

Eastern.—Chairman: Dr. Robert F. Ridpath, 18th and Chestnut Sts., Philadelphia.
Place: New York. Time: Jan. 16, 1948.
Southern.—Chairman: Dr. Walter T. Hotchkiss, 541 Lincoln Rd., Miami Beach, Fla.
Place: New Orleans. Time: Jan. 23, 1948.
Middle.—Chairman: Dr. Oliver E. Van Alyea, 135 S. La Salle St., Chicago.
Place: Columbus, Ohio. Time: Jan. 19, 1948.
Western.—Chairman: Dr. Colby Hall, 1136 W. 6th St., Los Angeles, Calif.
Place: San Francisco. Time: Jan. 31-Feb. 1, 1948.

American Otological Society

President: Dr. Bernard J. McMahon, 634 N. Grand Blvd., St. Louis.
Secretary: Dr. Gordon D. Hoople, 713 E. Genesee St., Syracuse, N. Y.
Place: Old Homestead, Va. Time: April 12-13, 1948.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Alfred Schattner, 115 E. 61st St., New York.
Secretary: Dr. Norman N. Smith, 291 Whitney Ave., New Haven, Conn.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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